DEPARTMENT OF DEFENSE APPROPRIATIONS FOR 1961

HEARINGS

BEFORE THE

SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS HOUSE OF REPRESENTATIVES

EIGHTY-SIXTH CONGRESS

SECOND SESSION

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PART 6

Research, Development, Test, and Evaluation

Printed for the use of the Committee on Appropriations

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DEPARTMENT OF DEFENSE APPROPRIATIONS FOR 1961

AFTERNOON SESSION

WEDNESDAY, MARCH 9, 1960.

RESEARCH AND ENGINEERING

WITNESSES

HON. H. F. YORK, DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
BEN G. HUFF, DIRECTOR OF THE OFFICE OF REVIEW AND SERVICES
DR. E. B. DOLL, VICE PRESIDENT AND ASSOCIATE DIVISION DIRECTOR, TECHNOLOGY LABORATORIES, INC.

Mr. MAHON. The committee will come to order..

This afternoon we shall begin consideration of the "Research development, test, and evaluation" appropriation. Our first witness is the Director of Defense Research and Engineering.

Dr. York, we are pleased to have you before us again. We are very much concerned about numerous questions in the field of defense with which you are associated.

I have a feeling that there are those in industry and in Government who feel that you are placing a barricade before certain projects which they think are very important. I am sure that there are also those who feel that you are placing your stamp of approval on projects that are unsound and probably represent a waste of money.

You are in a position in which you cannot possibly please everybody. You are in a very strategic position, and you have a very challenging responsibility.

The Air Force is very much wedded to the B–70 bomber. Officials do not seem to have any doubt as to whether or not it is a practical venture. Many are inclined to discredit our air defense systems and insist that we are spending too much money in this area when actually perfect air defense is not attainable.

There are many important things which, one way or the other, are related to your shop.

I have been looking forward, as I know other members of the committee have, a long time to the opportunity of having you before us. You were before us as a backup witness when the Secretary of the Air Force was here.

All we can expect of you is your own opinions and judgments in the context of questions and situations which arise during this presentation.

I assume you propose to read a formal statement which you prepared for the committee?

Dr. YORK. Yes, sir. It is fairly long but it does cover some of the points you raised.

Mr. MAHON. I think it is good to have a prepared statement in the interest of orderly procedure.

We are pleased to have you and without objection you may proceed, without interruption, with your statement.

GENERAL STATEMENT OF THE DIRECTOR OF RESEARCH AND ENGINEERING

Dr. YORK. Mr. Chairman and members of the committee, I am pleased to appear again before this committee and to present to you the highlights of the research, development, test and evaluation portion of the defense program and budget proposed for fiscal year 1961.

Last year when I appeared before your committee, I had not participated in the program reviews which led to the fiscal year 1960 defense budget. This year, however, in keeping with the increased authority and responsibility given to the Director of Defense Research and Engineering, under the Reorganization Act of 1958, I participated extensively in the reviews of those programs proposed for the fiscal year 1961 budget to be funded under the R.D.T. & E. title, or which had major technical or research and engineering implications.

Beginning in September of last year my staff, working with the staffs of the military departments and the Assistant Secretary of Defense (Comptroller) devoted the major part of its time to the intensive review of the programs submitted by the military departments and the Advanced Research Projects Agency in support of their fiscal year 1961 R.D.T. & E. budget requests, plus those programs of a development, test, and evaluation nature which are still separately identified in the procurement accounts of the Navy and Air Force. In addition, I personally conferred with the senior civilian and military officials of all the military departments who are concerned with research and development activities, and I took part in nearly all the top level discussions of the fiscal year 1961 budget conducted by the Secretary of Defense.

In this way the appropriate technical judgments were brought into consideration in developing the fiscal year 1961 defense program and budget. In particular, I found the practice of almost daily conferences with the senior research and engineering officials of the Department of Defense to be a most useful practice, and I intend to continue this technique.

To strengthen the capability of my office generally and to assist particularly in the program review process, I have added to my office a number of assistant directors in various systems areas including air defense, communications, special projects, strategic weapons, tactical weapons, and undersea warfare. This has enabled systems review to be made of programs as well as the technical review which has been done in the past. This systems review encompasses the concept of long-range planning, since the complex weapons systems reviewed by these assistant directors necessarily involve long leadtimes and a severe drain on resources.

Better integration of technology, intelligence, and strategy is being achieved through closer and virtually continuous coordination with the Joint Chiefs of Staff and other principal military officers.

Another organization change which should strengthen and simplify the administration of the defense research and engineering program has been to place the Advanced Research Projects Agency directly under the supervision of my office. ARPA was first established in early 1958 to handle those research projects which had not yet developed to a point where they could logically be assigned to any one of the military departments. Now that civilian space projects are being administered by the National Aeronautics and Space Administration and most of the military space projects involving hardware development and procurement are being transferred to the military departments, the Advanced Research Projects Agency can now devote its efforts to the advanced research so vitally needed to assure superior military weapons for the future. With the committee's permission, I would like to place in the record at this point, a copy of the directive dated December 30, 1959, placing ARPA under my office.

Mr. MAHON. All right, you may do that.

(The information follows:)

December 30, 1959
Number 5129.33
AdmAsst, S/D

DEPARTMENT OF DEFENSE DIRECTIVE

Subject: Department of Defense Advanced Research Projects Agency.

I. GENERAL

Pursuant to the authority vested in the Secretary of Defense and the provisions of the National Security Act of 1947, as amended, including the Department of Defense Reorganization Act of 1958, an Advanced Research Projects Agency is hereby established as an operating research and development agency of the Department of Defense under the direction and supervision of the Director of Defense Research and Engineering.

II. ORGANIZATION AND RESPONSIBILITY

The Advanced Research Projects Agency will be separately organized within the Department of Defense under a Director of Advanced Research Projects appointed by the Secretary of Defense. The Agency will be responsible for basic and applied research and development for such advanced projects as the Director of Defense Research and Engineering assigns.

III. FUNCTIONS

Under the direction and control of the Director of Advanced Research Projects, the Agency will perform the following functions within its assigned field of responsibility:

1. Engage in assigned advanced research projects.
2. Arrange for the performance of and supervise the work connected with assigned advanced projects by the military departments, other Government agencies, individuals, private business entities or educational or research institutions, giving consideration to the primary functions of the military departments.
3. Recommend to the Director of Defense Research and Engineering the assignment of advanced projects to the Agency.
4. Keep the Director of Defense Research and Engineering, the Joint Chiefs of Staff, the military departments and other DOD agencies informed, as appropriate, on significant new developments, breakthroughs and technological advances within assigned projects and on the status of such projects in order to facilitate early operational assignment.
5. Such other functions as the Secretary of Defense or the Director of Defense Research and Engineering assigns.

IV. RELATIONSHIPS

A. In the performance of its functions, the Agency shall—

1. Coordinate actions, as appropriate, with the military departments and other DOD agencies having collateral or related functions in the field of its assigned responsibility.

2. Maintain active liaison for the exchange of information and advice in the field of its assigned responsibility with the military departments, other DOD agencies, and appropriate research and development agencies outside the Department of Defense, including private business entities, educational or research institutions, or other agencies of Government.

3. Make full use of established facilities in the Office of the Secretary of Defense, military departments and other DOD agencies rather than unnecessarily duplicating such facilities.

B. Officials of the Office of the Secretary of Defense, military departments, and other DOD agencies shall provide support, within their respective fields of responsibility, to the Director of Advanced Research Projects as may be necessary to carry out the assigned responsibilities and functions of the Agency.

V. AUTHORITIES

A. The Director of Advanced Research Projects, in the assigned field of responsibility of the Agency, is hereby specifically delegated authority to—

1. Place funded work orders with the military departments or other DOD agencies, or directly with subordinate activities of the military departments, after clearance with the Secretary of the Department concerned.

2. Enter into agreements with other Government agencies for basic and applied research and development work connected with assigned advanced projects.

3. Authorize the allocation, transfer, or expenditure of funds made available to the Agency for assigned advanced projects.

4. Establish for the Agency and with the military departments and other research and development activities such procedures as are required in connection with work being performed for the Agency consistent with policies and instructions governing the Department of Defense.

5. Acquire or construct such research, development, and test facilities and equipment as are required to carry out his assignments and as may be approved by the Secretary of Defense in accordance with applicable statutes.

B. Other authorities specifically delegated by the Secretary of Defense to the Director of Advanced Research Projects in other directives will be referenced in an enclosure to this directive.

VI. PROJECT ASSIGNMENTS

Announcements of the assignment of projects to the Advanced Research Projects Agency by the Director of Defense Research and Engineering will be made from time to time by numbered enclosures to this directive.

VII. SUPPORT

Such personnel, facilities, and funds as the Secretary of Defense deems necessary will be made available to the Advanced Research Projects Agency for the performance of its assigned responsibilities.

VIII. CANCELLATION

DoD Directive 5105.15, dated March 17, 1959, except for enclosures numbered 3, 4, 5, 7, 8, 9, 10, 14, and 16, is hereby canceled. The above numbered enclosures which are excepted from this cancellation will be renumbered 2 through 10, respectively, and will remain in effect as enclosures to this Directive until otherwise modified or rescinded by the Director of Defense Research and Engineering.

IV. EFFECTIVE DATE

This Directive is effective upon publication.

THOMAS S. GATES,
Secretary of Defense.

REFERENCE TO OTHER AUTHORITIES SPECIFICALLY DELEGATED BY THE SECRETARY OF DEFENSE TO THE DIRECTOR OF ADVANCED RESEARCH PROJECTS AGENCY IN OTHER DIRECTIVES

No other authorities have been specifically delegated by the Secretary of Defense to the Director of Advanced Research Projects Agency as of the date of this directive. Any future specific delegations will be referenced in an enclosure to this directive.

PROJECT ASSIGNMENT TO ARPA

1. Project designation

Basic Defense Research. Short title: Sunrise.

2. Project description

The Advanced Research Projects Agency, on behalf of the Department of Defense, will undertake analyses and investigations to identify and make contributions of a conceptual nature to the basic technical problems vital to national defense which may not now be receiving adequate attention by the scientific community and to advise the Secretary of Defense through the Director of Defense Research and Engineering of scientific developments on which projects might be initiated which would enhance the national security.

3. Specific provisions or instructions

Approval by the Director of Defense Research and Engineering will be required for work beyond the initial study phase.

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Projects assignments

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(Classified)	9
(Classified)	10
Sunrise	11

Dr. YORK. Before proceeding on to a discussion of our more significant programs, I would like to present to the committee a brief fiscal summary of the research and development test and evaluation title.

The new obligational authority requested for the R.D.T. & E. title totals $3.9 billion. This compares with NOA of $4.2 billion for fiscal year 1960 and about $3.8 billion in 1959. Expenditures under this title in fiscal year 1961 will amount to $3.9 billion compared with about $3.7 billion in 1960, and $2.9 billion in 1959.

However, because of the carryover of unobligated funds from prior years, trends in NOA can be misleading. Similarly, because expenditures always lag the actual work undertaken, it is direct obligations which are, perhaps, the best overall measure of the program actually planned to be implemented in a given fiscal year. For this reason, it may be most useful to the committee if my subsequent fiscal references were chiefly in terms of direct obligations.

The 1961 budget on this basis shows a total of almost $4 billion planned for obligation under the title of "Research, development, test and evaluation." This is about $300 million less than planned obligations for 1960, but over $400 million more than 1959.

As the committee is aware, the 1961 budget carries one step further the effort to differentiate more clearly between "procurement" for general operational use on the one hand, and "research, development, test and evaluation" on the other hand. The initial step in this process—which the committee was instrumental in initiating—was taken in last year's budget. The Army largely completed these adjustments in the 1960 budget. In the case of the Navy, the necessary additional adjustments were substantially completed in the preparation of the 1961 estimates. The Air Force has made additional adjustments of this nature in the 1961 budget, but for a variety of administrative and accounting reasons has not completed all of the transfers which theoretically could be made. Some major development projects nearing the completion of their test and evaluation phase—mainly certain aircraft and ballistic missiles—remain in their traditional place in the "procurement" appropriation, but they are clearly identified as separate budget activities.

If the amounts for these separately identified items in the "procurement" accounts are added to the regular R.D.T. & E. amounts previously mentioned, total obligations for all "research, development, test and evaluation" activities amount to about $5.3 billion in 1961, compared with $5.8 billion in 1960 and $5.1 billion in 1959. (On the same combined basis, expenditures for these activities in 1961 are estimated at $5.3 billion—the same high level as in 1960 and $1 billion more than in 1959.)

The somewhat lower level of obligations planned for fiscal year 1961 results from a number of factors. For example, SATURN is being transferred to the National Aeronautics and Space Administration. Some projects, such as the F–108, have been terminated; others, such as the B–70, have been sharply curtailed. Moreover, certain major development projects such as the ATLAS missile are progressing out of the R.D.T. & E. stage and into the production and procurement phase.

Since much of the increase in funds over the past few years represents hardware developments, questions may be raised concerning the support of research programs, particularly basic research programs. Although the total research program as identified by projects has been maintained at about the same level as fiscal year 1960, the basic research program, similarly identified, has been increased by about 10 percent over fiscal year 1960. Our policy is to encourage basic research in all disciplines having possible military potential as well as research in materials and components having more immediate application to military programs. In this latter connection we have requested the Advanced Research Projects Agency to manage a program of basic research in materials on an interdisciplinary basis in fiscal year 1961. To get this program underway in this fiscal year, we have reprogramed ARPA funds and your committee has been so informed.

We intend to continue our close relations with the National Aeronautics and Space Administration on programs with both military and civilian application. As Secretary Gates has already stated, the De-

partment of Defense is not directly concerned with space flight and exploration as ends in themselves. Our space efforts are an integral part of our overall military program and will complement other military capabilities. As space technology expands, new military requirements are likely to materialize. Our objectives, therefore, are (1) the development, production and operation of space systems which will enhance the overall defense program; and (2) the development of components for systems the need for which cannot be clearly demonstrated at this time, but which probably will become necessary in the future. Thus, considering the nature of our space objectives it is not logical to formulate a long-range military space program which is separate and distinct from the overall defense program.

While we are admittedly behind the Russians in the development of very large thrust boosters, the use of IRBM's and ICBM's as first stage boosters for our near earth satellites provides us with a payload capability adequate for our immediate military needs. Within a year or two we expect to have considerably more weight-carrying ability with our improved upper stage space vehicles.

The R.D.T. & E. program covers many subjects and a wide field of effort. The program consists of approximately 2,000 projects which represent some 15,000 tasks. These vary in type, scope and magnitude of effort from major developments such as NIKE-ZEUS, POLARIS or MINUTEMAN to small basic research tasks, such as medical investigations or materials studies. Approximately 72 percent of the program is accomplished by contract with industrial organizations, 7 percent by educational and other nonprofit institutions and 21 per cent by Federal Government installations.

For budget purposes, the overall Department of Defense research, development, test and evaluation effort is organized by budget activities. Mr. Chairman, with the committee's permission, I would like to place in the record at this time a table giving the direct obligations for these budget activities for fiscal years 1959, 1960 and 1961, together with a series of brief résumés of the general type of work undertaken under the heading of each of these budget activities.

Mr. MAHON. You may do so. Proceed.

(The information follows:)

RESEARCH, DEVELOPMENT, TEST, AND EVALUATION

Direct obligations, fiscal years 1959–61

[Millions of dollars]

	1959 actual	1960 estimate	1961 estimate
Military sciences	401.7	549.1	535.2
Aircraft and related equipment	419.5	502.0	446.2
Missiles and related equipment	1,343.5	1,498.3	1,481.6
Military astronautics and related equipment	324.1	468.0	318.0
Ships and small craft and related equipment	163.4	164.4	151.5
Ordnance, combat vehicles, and related equipment	197.0	198.9	177.5
Other equipment	434.4	558.3	460.5
Programwide management and support	251.0	248.4	231.0
Emergency fund		141.0	150.0
Total direct obligations	3,543.6	4,268.4	3,951.5

Budget Activities

MILITARY SCIENCES

This activity includes basic research in the life, physical, and social sciences to add to the store of fundamental scientific knowledge; applied scientific research of importance for military purposes; operations research; and the development of new materials, components, and techniques. Among the many and widely varied problems to be investigated under this activity mainly are materials with physical properties superior to those presently available, higher performance rocket fuels, thermoelectric materials, nonlethal chemical and biological agents, neurosensory phenomena, radio astronomy, oceanography, high altitude phenomena, cargo packaging, blood substitutes, nuclear phenomena, advanced radar techniques, more reliable electronic components, underwater sound propagation characteristics, and automatic data processing. In addition to the amounts in this activity, basic and applied research performed within overhead arrangements on some procurement contracts is funded in the procurement accounts. Supporting research associated with development projects is funded under the other activities below. The principal support of such organizations as the Naval Research Laboratory, the Air Force's Cambridge Research Center and Rand Corp. and the Army's Operations Research Office and Human Resources Research Office is provided under this activity in addition to work performed by universities, nonprofit organizations, and industry.

AIRCRAFT AND RELATED EQUIPMENT

This activity funds research, development, test, and evaluation related to airframes, engines, armament, electronic devices, and other installed equipment, except that procurement of new types of operational aircraft in quantity for test and evaluation and certain major developments are funded under the procurement accounts. Research and test centers primarily funded under this activity include the Air Force's Arnold Engineering Development Center and Flight Test Center and the Naval Air Test Center.

MISSILES AND RELATED EQUIPMENT

This activity provides for research, development, test, and evaluation of guided missiles of all types except that procurement funds are used for the major portion of the development work on Air Force ballistic missile systems and for completion of development, test, and evaluation of certain other missiles which are already being procured in quantity for operational use. In addition to funding industrial participation in the missile research and development program, this activity is the principal source of funds for the operation of such development and test centers as the Atlantic, Pacific, and White Sands Missile Ranges; the Air Proving Ground and Missile Development Centers of the Air Force; the Naval Ordnance Test Station and Applied Physics Laboratory of the Navy; and the Diamond Ordnance Fuze Laboratory of the Army.

MILITARY ASTRONAUTICS AND RELATED EQUIPMENT

This activity provides for the conduct of programs directed at the improvement of space technology for military purposes and the investigation of specific military applications of space vehicles. Research and development in such areas as upper stage propulsion, secondary power, guidance, navigation components, and payload equipment for space and satellite systems are included under this activity. The Advanced Research Projects Agency continues to sponsor research and development leading to the demonstration of operational feasibility of communications and navigation satellites for possible military applications.

SHIPS AND SMALL CRAFT AND RELATED EQUIPMENT

This activity provides for research, development, test and evaluation related to ships and small craft, except that funds are included in the regular shipbuilding appropriation for the construction of ships of advanced design and ships employed in the development, test, and evaluation of new components and techniques. Funds in this activity provide for the development of advanced engines and propulsion machinery, communications and other shipboard electronic equip-

ment, catapults and arresting gear, and other installed equipment. A significant part of the research and development effort of the Naval Electronics Laboratory and David Taylor Model Basin is funded under this activity.

ORDNANCE, COMBAT VEHICLES, AND RELATED EQUIPMENT

The Army's program includes improved artillery, rockets, mortars, antitank weapons, tank armament, and small arms. Vehicle development includes tactical carriers and high mobility logistic transporters. The Navy program emphasizes antisubmarine weapons and includes mines, depth charges, torpedoes, bombs, rockets, and other types of ammunition. Weapons and support vehicles for the Marine Corps are also provided for in this activity. Air Force effort included under this activity is concerned with the development, test, and evaluation of ammunition, rockets, and bomb components related to Air Force applications. This activity provides the principal support of the Naval Ordnance Laboratory and of research, development, test, and evaluation activities at several Army arsenals.

OTHER EQUIPMENT

This activity provides for research, development, test, and evaluation of equipment not separately provided under other activities. Examples of the types of equipment under development are communications equipment in all three services; mine warfare, combat surveillance, materials handling, obstacle crossing equipment, and protective clothing and equipment for the Army; navigation, detection, and warning equipment, and shore-based antisubmarine and mine countermeasures systems in the Navy; and photographic and personal equipment, and aircraft control and warning, missile detection, and other electronic systems in the Air Force. Much of the support of the research and development effort of the Lincoln Laboratories and the Signal Research and Development Laboratory is provided under this activity by the Air Force and Army, respectively.

PROGRAMWIDE MANAGEMENT AND SUPPORT

This activity provides for those costs of operation, management, and maintenance, of research, development, and test facilities of the Department of Defense which are not distributed directly to the other budget activities, and for certain costs of central administration such as the headquarters of the Air Research and Development Command.

Dr. YORK. I would now like to discuss in greater detail some specific programs in the fiscal year 1961 budget under appropriate operational headings.

STRATEGIC WEAPONS

Manned aircraft for the strategic retaliatory forces, and their associated weapons and equipment, still receive an important fraction of our total research, development, test, and evaluation effort. Some of the most important and difficult program decisions had to be made in this area.

The B–52 heavy jet bomber force represents the hard core of our strategic retaliatory power at the present time and will undoubtedly occupy this central position for some time to come. The B–52 is a key weapons system and one whose great growth potential has been exploited by a series of highly successful developmental programs. For example, the unrefueled range of the B–52G, currently coming into operational service, is considerably greater than that of the earliest models. The introduction of the new turbofan jet engine in the B–52H's—included in the 1961 Defense budget—will provide still another increase in range of about 15 percent. These successive increases in range, while important even as incremental gains in performance, are even more important on a cumulative basis. Late model B–52's can now attack many Soviet targets from bases in the

United States without any reliance on in-flight refueling. This achievement represents an operational advantage of considerable significance.

The only other manned strategic bomber currently under procurement is the supersonic B–58 medium jet bomber. This aircraft is in the final stages of its test and evaluation program and will be entering operational service shortly. As might be expected, in developing the first manned bomber capable of supersonic speeds, the B–58 has had its share of developmental problems—particularly those involving high-speed flight characteristics and the bombing-navigation system. These problems have been overcome and the B–58 will bring to the manned bomber force for the first time a supersonic penetration capability.

The B–70 is being continued on a curtailed development basis in the fiscal year 1961 budget. The present program is oriented toward the development of airframe, engines, and critical subsystems to be available for prototype flight testing in 1963.

The B–70 would be a large, heavy, intercontinental bomber in the same weight class as the B–52, but capable of cruising flight at speeds of Mach 3 and altitudes in excess of 70,000 feet. In terms of manned aircraft development, it will represent a considerable advance in the state of the art. For the first time, among other novel problems, a manned bomber would have to contend seriously with the thermal barrier; that is, the aerodynamic heating in cruise flight at Mach 3 would be so substantial as to pose serious problems of cooling and structural integrity.

Under the original plans the B–70 would have been available in operational quantities at the earliest in 1965 and more probably somewhat later. The B–70, therefore, would be available in a period when intercontinental ballistic missiles will be deployed in quantity and when their reliability will have been greatly increased. This raises a serious question as to whether the very costly effort needed to complete the development of this aircraft system is justified, in view of the alternative strategic delivery systems available at that time.

The B–70 would not be nearly as sure of penetrating enemy defenses as a ballistic missile. Nevertheless, it would offer greatly improved capability for penetrating enemy defenses as compared to our present bomber force and in addition would retain the unique advantage of the manned bomber such as the ability to be placed on airborne alert status, thereby reducing vulnerability to surprise ICBM attack: moreover, it can be launched on uncertain warning and recalled if necessary; and it can attack targets whose geographic locations are not precisely known in advance. It seemed unwise, therefore, to foreclose the development of these capabilities, and it was decided to request funds to continue development work on the basis which I have already described to you. Within the next year, we expect to have the facts available to make a decision on the future course of the B–70 development.

The development of air-to-surface missiles such as the HOUND DOG will greatly improve the ability of manned bombers to penetrate targets heavily defended by modern air-to-surface missiles. The B–52 force, equipped with supersonic, air-breathing HOUND DOG missiles, can attack heavily defended targets from a distance of sev-

eral hundred miles without actually exposing themselves to concentrated fire of ground defenses. The development of the HOUND DOG missile, which is now well advanced, has been a factor of immense significance in extending the operational effectiveness of the manned bomber force.

The ability to launch such air-to-surface missiles has become an essential feature of any future bomber. A second step along this line of development has already been undertaken. Preliminary work on an air-launched, intermediate range ballistic missile—sometimes referred to as the SKYBOLT—has begun. This missile will be virtually immune to interception and will have double the range of the HOUND DOG.

Also important in enhancing the ability of manned bombers to penetrate modern enemy defenses are radar decoy missiles such as the QUAIL. These simulate the appearance of a B–52 and divert enemy defensive action. Particularly crucial to this ability is the provision of advanced electronic countermeasures equipment. New and more effective devices of this kind are vitally important in assisting manned bombers to confuse or saturate enemy detection and control systems. Their development is receiving appropriate attention.

The programs I have described thus far are true weapons systems for the retaliatory forces. Three other major research and development projects are being pursued that are logical extensions along this line but have not yet progressed to the point where they can be thought of as actual weapons systems. Work continues on the nuclear-powered aircraft (ANP) under the joint sponsorship of the Department of Defense and the Atomic Energy Commission. Work is being done with both the direct and indirect cycle nuclear powerplants by General Electric and Pratt & Whitney, respectively, but many very difficult engineering and developmental problems remain. A nuclear-powered bomber with suitable operational characteristics probably lies beyond 1970.

The X–15 rocket-powered research aircraft, designed to explore the speed range up to about mach 6, is currently undergoing its initial tests at Edwards Air Force Base in California. Beyond the X–15, the Air Force is working on Dynasoar, a manned, maneuverable, rocket-powered, boost-glide vehicle capable of near orbital speeds and controlled landings.

The other major category of our strategic retaliatory force is, of course, the ICBM's. The ATLAS ICBM is now operational at Vandenberg Air Force Base, but substantial developmental work and testing continues at Cape Canaveral. TITAN is well along in its flight test program despite the recent series of failures—which you know was broken by its latest successful full-range test roughly 3 weeks ago. The TITAN troubles, while disconcerting as reported in the press, are essentially of the same kind as we experienced in the older ATLAS program and which must be expected in any development program of this kind.

A question that often arises in connection with the ATLAS and TITAN ICBM program is "Why both"? The answer can be summed up by saying that ATLAS is available now and provides ICBM strength at the earliest possible time. TITAN, on the other hand, provides improved performance, increased sophistication, and greater

growth potential. It is more adaptable to the storable, or noncryogenic, fuels which should appreciably shorten its reaction time; it is also more adaptable to in-silo launch, which of course depends on having an all-inertial guidance system among other things. It is a true two-stage missile, which should allow it to carry heavier warheads. Furthermore, its rigid structures makes it better adaptable to adding heavy upper stages for space work.

The POLARIS program is proceeding satisfactorily. The flight test program for the missile itself is on schedule and the associated problems involving underwater launch, communications, and navigation look capable of solution.

With respect to the MINUTEMAN ICBM, the Department of Defense is utilizing in the current fiscal year the $87 million in additional funds provided by the Congress to accelerate work on this system. The advantages of the MINUTEMAN concept are well known to you: High degree of readiness; short reaction time; small size; capability for deployment on mobile platforms or in hardened sites; and reduced cost.

The development of very large, high-thrust, solid-fuel rocket motors has involved not only new problems in solid fuel chemistry, precise control of rates of burning, etc., but also has required the development of wholly new manufacturing techniques. Under an accelerated effort, these problems are being met and overcome and we expect MINUTEMAN to be deployed in significant numbers by mid-1963.

AIR DEFENSE

A substantial portion of our research and development effort is devoted to continental air defense. As this committee is aware, the problem of continental air defense is divided into two distinct parts: (1) defense against manned aircraft and (2) defense against ballistic missiles.

Our defense system against attack by manned bombers is largely completed. The present research and development effort in this field is devoted primarily to improving and extending the capabilities of present equipment. Some work is being done on the solid-state computers needed for the semiautomatic ground environment (SAGE) system and in basic radar techniques such as Project Madre. Just as airborne ECM equipment is important to our own manned bombers so, too, our detection and control systems must be prepared to cope with enemy electronic countermeasures. Radar frequency diversity and other techniques are being exploited to enable our radar and communications systems to function in a hostile electronic environment.

In the field of air defense weapons, research, development, test, and evaluation work is going ahead on an improved SIDEWINDER, and on the FALCON and EAGLE missiles. These improved air-to-air missiles with greater range, accuracy, or lethal radius are one of the most effective ways of increasing the kill capability per sortie of our present manned interceptor force.

BOMARC B, with an effective range of about twice that of the BOMARC A model also provides a means of making bomber interceptions farther out from our own borders. The recent series of flight test failures on the BOMARC B was caused by difficulties in a fuel

metering valve in the sustained ramjet engine. This defect has now been corrected. While the last BOMARC B test was not completely successful, the difficulty was one involving guidance and not the "fix" on the faulty valve.

At the time I wrote this, this was the last, but it is now the next to the last.

Mr. FLOOD. The last is on March 5?

Dr. YORK. Yes, sir.

The last was also unsuccessful.

At the time I wrote this, this was the last, but it is now the next to this country is shifting from manned aircraft attack to attack by ballistic missiles. A very considerable portion of our total research and development effort is being devoted to attempts to meet this new and extremely difficult problem.

The first task in this area is to provide warning, for on it depends our ability to launch SAC and to prepare ourselves for the oncoming attack. Work on the Ballistic Missile Early Warning System (BMEWS) is well under way. This system as you know, by means of very large and immensely powerful radars, can detect incoming ballistic missiles at about the midpoint in their trajectory. It thus provides about 15 minutes of warning time. This warning time, while extremely short, is of the most critical nature to our Strategic Air Command.

The first BMEWS station is expected to be in operation late this fall. Even this partial coverage will be of great significance since inevitably it would detect some portion of a mass intercontinental ballistic missile attack on this country. The other two stations in this system are expected to come into operation at about one year intervals thereafter.

MIDAS, a satellite based detection system employing infrared sensors which could detect the great blast of heat accompanying an ICBM launch, is being vigorously pursued.

MIDAS is a particularly attractive system since it could provide an almost instantaneous warning to a massive ICBM launching and would thus give roughly double that available from BMEWS. With 30 minutes of warning, a very large part of the Strategic Air Command could be launched from their bases.

While passive measures for the detection of an ICBM attack are extremely important, it would be of the greatest advantage to have some form of an effective active defense against incoming ballistic missiles. At the present time, the NIKE-ZEUS system is the most advanced system and the only one under development.

During the last 2 years, we have greatly accelerated our effort on the NIKE–ZEUS antimissimle missile. While substantial progress is being made in developing this system, the technical problems involved are most difficult. Within a period of minutes, the relatively small incoming warhead and possible accompanying decoys must be detected, tracked and identified. Within a period of almost literally seconds the actual warhead's final trajectory must be computed and a number of ZEUS antimissile missiles fired and guided to the interception point. The speed, reliability and precision required of this system present unprecedented technical problems.

The missile itself, while not involving any radical breakthroughs in technology, would require very large solid fuel boosters, and would have to be armed with a rather sizable nuclear warhead. Furthermore, the effective radius that could be defended by a NIKE–ZEUS battery would be relatively small. This would mean that even for a program to defend only a part of the United States, a tremendous investment—up to $15 billion—would be required.

After the most painstaking review, it was decided to press forward as rapidly as practicable with the research, development, test and evaluation of this system but not to place it into production. The funds required for fiscal year 1961 will provide the necessary radars, computers, target missiles, defense missiles, test range facilities, and other equipment required to carry out a full-scale realistic test program to determine the operational feasibility of the complete NIKE-ZEUS system. It is expected that these tests will provide the basis for a final decision on NIKE-ZEUS.

In the meantime, we are sharply stepping up our basic research and development effort in the field of active missile defense through Project Defender. The purposes of this project are:

(1) To explore all of the phenomena associated with missile flight which might be useful in solving the defense problem, and

(2) To examine the possibilities for applying other techniques to the problems of detection, discrimination, interception, and kill of enemy ballistic missiles. A major objective of Defender will be to find means for making an interception of an ICBM during any phase of its flight.

In providing air defense for the fleet, the point of diminishing returns sets in even sooner than it does with respect to continental air defense. Naval interceptors, air-to-air missiles, surface-to-air missiles such as TALOS, TERRIER, and TARTAR, and a great host of complex electronic detection, control, and communications equipment are required to defend the fleet from air attack. If allowed to develop unchecked, the cost of these programs might easily rise to a level between $1½ to $2 billion annually. Considering the relatively small size of the striking force they are intended to protect, this would seem to be a disproportionate share of our resources to invest in a purely defensive function. Again, the problem is one of not dissipating available resources over too many projects, and of not trying to buy marginal improvements at excessive cost.

UNDERSEA WARFARE

Three critical navel problems are protecting the United States from attack by missile-launching submarines, defending task forces and convoys against submarines, and preventing losses from enemy mining operations. The Navy is working to solve these problems through the development of longer range submarine-detection devices and improved antisubmarine ships, aircraft and weapons.

Nuclear power, which makes possible greater speed and practically unlimited submerged endurance, should give our submarines an edge over enemy antisubmarine forces. Carrying guided missiles with nuclear warheads, our nuclear-powered submarines will constitute a tremendous threat to enemy inland targets. Since we must assume that our competitors are also developing these weapons, the Navy is

working hard to find ways of coping with such a threat against the United States.

Improved equipment is being developed for detecting submarines, particularly when they are fully submerged. Underwater-sound-detection devices (sonars) are used to listen for noisy submarines or to provide range measurements by bouncing underwater sound waves off a submarine and receiving the echoes.

Some of the newer sonars are lowered into the water from helicopters, greatly increasing the effective detection and weapon ranges of the mother ships. Expendable sonars (sonobuoys) dropped from carrier or shore-based aircraft increase considerably the speed at which an area can be searched for submarines. These sonobuoys contain radios which transmit submarine information back to the parent aircraft. New sonars, planned for use on surface ships or submarines or on the sea bottom, are expected to increase substantially the distances at which submarines can be detected.

Work is proceeding on new antisubmarine weapons, including much improved target-seeking torpedoes that are like underwater guided missiles, rocket-launched torpedoes from ships, and submarine-launched antisubmarine missiles of substantial range.

It is a dangerous, time-consuming job to neutralize mines, once they are laid. The surest way to counter mining attacks is to destroy the minelayers before they can lay the mines. However, in most situations this is not possible. Also, when the submarine is the minelayer it is essentially undetectable. Therefore, maximum effort is being directed toward increasing the efficiency and speed of mine countermeasures and making it safer for the men who do the job by developing helicopters for minesweeping and high resolution sonars for minehunting.

TACTICAL WARFARE

In fulfilling its main responsibility for land-combat weapons and equipment, the Army is devoting a major effort to improving firepower, mobility, communications, and methods of acquiring combat intelligence.

Greater firepower is being developed in a variety of forms, both nuclear and nonnuclear, and capable of delivery by a number of modes: demolitions, guns, missiles, and bombs. An indication of scope is that the program includes more lethal small arms ammunition as well as much improved warheads for missiles ranging from the short-ranged, man-portable DAVY CROCKETT to the PERSHING missile. The application of improved firepower in ground-to-air defense weapons is being pushed hard in the tactical weapons area as well as in the strategic area with such systems as REDEYE, MAULER, and HAWK. The improved firepower includes not only improved explosives but many chemical and biological weapons capable of a wide range of effects from short duration incapacitation to lethality.

Greater mobility will be achieved in several ways: (1) by reducing equipment weight—the new carriage for the 175-mm. gun and the new armored personnel carriers will weigh only half as much as their predecessors; (2) by decreasing logistical demands; e.g., large missiles using solid propellants will not require oxygen-generating equipment; and (3) by improved design. Examples of gains through bet-

ter design are (1) the Goer, a large-wheeled logistic vehicle, based on recent developments in heavy earthmoving equipment, that can cross extremely rugged terrain; and (2) the V/STOL type mobility aircraft to help solve the landing-field problem for all three services.

The Army is in the initial phase of the development of a family of vertical and short takeoff and landing transport, observation and utility aircraft directed toward fulfilling the air mobility requirement for the 1963–70 time period. The Navy is including the development of a Marine assault transport in their program. Practical solutions of technical and operational problems associated with the development of V/STOL aircraft are being sought through an aggressive R. D. T. & E. program. We expect that by having the least number of different types of aircraft increased quantities and maximum utilization by all services can be obtained.

Land-combat situations of the future are expected to involve many small, hard-hitting, highly mobile units, widely dispersed over the battle area. This concept calls for an extremely flexible communications system to keep the units in touch with each other and with their commander. There has been solid progress to date but much more is needed and is being done to reduce the size and weight of the equipment while at the same time increasing its performance characteristics.

The faster moving, wider ranging warfare we anticipate has similarly generated extremely difficult requirements for improved battle area surveillance. Progress to date has yielded much improved radars and other sensors as well as improved platforms for positioning the sensors over the desired area of surveillance. Much is still needed and requires the present continuing broad program to produce surveillance systems equipment which can survive, search out and acquire the desired information and process it in a timely and usable form.

Additionally, several programs involving development of tactical aircraft systems are planned by the Air Force and Navy. These include the A2F, improvements in the BULLPUP, and an increased emphasis on development of an STOL fighter-bomber aircraft for the Tactical Air Command.

In the area of air logistics the Air Force is giving consideration to the development of a long-range transport aircraft directed toward the improvement of the MATS capability to rapidly deploy and support limited and general war forces. The need for intercontinental range, low loading height, high speed, ability to operate from unimproved airfields and the requirements of other potential users will necessitate design compromises to provide for cargo and troop airlift.

MILITARY SPACE

For the military space efforts funds are provided for satellite systems for early warning (MIDAS), reconnaissance (SAMOS), communications (COURIER) and navigation (TRANSIT). Related space efforts also include the development of improved solid and liquid rocket engines and of advanced guidance and communications techniques, and research in high altitude phenomena, and space medicine. The 1961 budget will also support an increased level of effort on component development for the DYNASOAR, discussed below under exploratory development.

ADVANCED RESEARCH PROJECTS AGENCY

Funds for the Advanced Research Projects Agency will support research on ballistic missile defense, solid propellent technology, and basic research on materials. The Director, Advanced Research Projects Agency, Brig. Gen. A. W. Betts, will appear before you tomorrow to present the ARPA program in greater detail.

EXPLORATORY SYSTEMS DEVELOPMENT

The Department of Defense is also carrying out a number of major development programs involving systems for which no specific approved operational requirement exists but which explore certain fields of applied technology which we believe will become very important in the future. These include, for example, the X–15 program designed to explore flight at speeds up to mach 6, and the DYNASOAR program, designed to explore controlled flight speeds up to mach 25 (reentry velocity) and altitudes up to several hundred thousand feet (reentry altitudes). The ANP program, which if successful, could provide us with a "breakthrough" with respect to range and endurance of aircraft, also belongs in this general category. In the case of the Navy, development of such systems as the large, very high speed hydrofoil boats may lead to altogether new concepts of antisubmarine and naval warfare. Similarly, the very deep going underwater craft such as the bathyscape are the advanced research vehicles for future deep-running submarines.

SUPPORTING RESEARCH

In addition to the systems developments described above, the services and ARPA also carry out extensive programs in applied and basic research.

Under the heading of "Applied Research" we include, for example, the bulk of the work in miniaturization and microminiaturization of equipment, research in materials, propellants, energy sources and conversion mechanisms, communications techniques, new methods for increasing the efficiency of high explosives, new chemical and biological agents and munitions and the means for defense against such agents, new propulsion techniques, improvements in photography, optics and infrared sources and detectors, defense against nuclear radiation, protective clothing, and a great many other similar problems.

Under the heading of "Basic Research," the Department of Defense sponsors a very broad program of scientific research in many fields of science, especially those where the potential military application of new discoveries is believed to be highest. For example, in 1961, we propose to make substantial increases in our support of oceanography and basic interdisciplinary research on materials. In the case of the former, oceanography, we believe that, since there is so much unknown about the oceanic environment, it is virtually inevitable that further basic research will yield discoveries of great importance in connection with ASW and other naval problems. With respect to materials research, nearly everything we do now in the development field could be done better if we had better materials. History shows that such has been the case in virtually every field of science and there is no doubt

that it will continue to be true. The basic research we do today is the foundation of tomorrow's applied science and next week's weapons systems.

For a number of years the Congress has provided the Secretary of Defense with an emergency fund appropriation and additional transfer authority. We again request $150 million for the emergency fund plus $150 million in transfer authority. I will provide additional information on the emergency fund when I testify on this subject tomorrow.

I believe that the R.D.T. & E. program presently underway and planned for fiscal year 1961 by the Department of Defense is in proper balance with the other important defense programs and that it is adequate to support our national military objectives.

This concludes my prepared statement. I will be pleased to answer any questions which you may have or to expand on any points that I could not include in this unclassified statement.

IMPORTANCE OF OFFICE OF DIRECTOR OF RESEARCH AND ENGINEERING

Mr. MAHON. Dr. York, in the olden days, warfare had to do with the employment of men and relatively simple weapons. The employment of men is still a very important consideration but it seems to me that one of the important matters now, one of the important fields of consideration, is that of technology regardless of our military men and what they may be able to do and regardless of their valor. They must not be completely outclassed from the standpoint of weapons if they are to win a war.

It seems to me that your office, while it might have been relatively unimportant 25 or 50 years ago, is extremely important at this time.

Do you foresee a continuation of this heavy emphasis on technology?

Dr. YORK. Yes; I do. It may very well even get heavier.

Mr. MAHON. Since it takes so long to develop a weapons system, it seems to me that any country is confronted with a rather serious problem if it fails to develop the right weapons.

If we fail to develop the right weapons, we could very well find ourselves completely out-gunned, so to speak, at some future time.

How can we have the assurance that we are not missing the boat, so to speak?

Dr. YORK. I do not know how you can have absolute assurance. The best you can do is to try and have as good an organization as you can, and that means at all levels, to carry on the program and to have it supported substantially.

CONTROL OF BASIC RESEARCH PROGRAM

Mr. MAHON. You have organized your office to deal with problems in various defense areas, such as air defense, strategic weapons, undersea warfare, and so forth. Have you set up any person or group to ride herd on basic research and university contracts?

Dr. YORK. No new group. There already was such a group when I took over the office.

Mr. MAHON. How strong and dependable is this technique that you are following with respect to basic research and college contracts?

Dr. YORK. In the first place, the original proposals and the work

in the field were largely done in the services with augmentation by ARPA, so that one question is, or one phase of this question is, how good are the services at handling the programs and at finding what is necessary?

We all know that the Office of Naval Research, through special legislation very early, was put in a very good position and has conducted an excellent program and the other services have in the last few years come to emulate that further. They are further improving their approach.

In my office, one of the offices that reports directly to me is called the Office of Science. It is staffed by a small number of competent scientists in the physical sciences and in the life sciences.

Working with them and with me is the Coordinating Committee on Science—a scientific research committee that advises us with respect to our programs and what we are doing.

In addition, as I mentioned, ARPA has come into certain fields of advanced research where we have felt there were some deficiencies. We get advice from a large numer of sources, such as the National Academy of Sciences, for instance, and they make inputs, both directed to us and to the services.

They have been helpful in the last few years—they, and the committee reporting to them of private citizens—in connection with oceanography and materials, for example. We also have close connections with the National Science Foundation and with other organizations in this field in and out of the Government.

There are information centers that have been established and these are more for the purpose of discovering overlaps, or looking for cases where one group's research applies to essentially everybody.

A certain amount of work is done with the Federal Council on Science and Technology on these matters.

Mr. MAHON. What are your plans for handling the projects under ARPA if this agency is abolished? I believe you have testified before other committees on this.

Dr. YORK. I testified before the Senate Armed Services Committee. Is that what you are referring to?

Mr. MAHON. No; the House.

Dr. YORK. Pardon me.

I testified that, in effect, the ARPA they were talking about virtually had been abolished and reconstituted as an arm of my office. They had received testimony from certain individuals to the effect that ARPA, in the form in which it existed last year, was unnecessary and undesirable. At that time it was an independent agency reporting directly to the Secretary of Defense, but that has been changed and now it reports directly to me.

X–15 PROGRAM

Mr. MAHON. As I understand it, the X–15 is not designed to be developed into a manned aircraft for operational use?

Dr. YORK. That is right, as such. It is designed to learn about flight at those speeds, if you want to develop an aircraft.

DYNASOAR PROGRAM

Mr. MAHON. What about the DYNASOAR? It is expected to develop into a vehicle for operational use?

Dr. YORK. The DYNASOAR program that the Air Force is now talking about is really parallel with the X–15 program more than with the usual weapons system program. The objectives of the first several phases in that program are really just to explore the problems in flight at those very high mach numbers and very high velocities that you would encounter in connection with reentry, or that you would encounter in connection with glide bombers, or things of that sort.

It, itself, is not a glide bomber or a weapons system in these phases.

If you were to develop a glide bomber, for example, you would have to start with the technology that DYNASOAR may produce, but I am certain that the weapons system would end up looking very different.

POLARIS PROGRAM PROBLEMS

Mr. MAHON. You have stated there were still some unsolved problems pertaining to the POLARIS missile and some unresolved in underwater launching.

How serious are these problems?

We have had Admiral Raborn and other witnesses before us and they seem to feel that they are out of the woods, completely out of the woods, on POLARIS.

Dr. YORK. It is more that there are untested problems rather than that they are unsolved.

I am in agreement with the Special Projects Office with regard to their assessment of POLARIS. I do not have any doubt POLARIS can be made to work and essentially on time.

Mr. MAHON. Do you feel that this is a weapon of great significance?

Dr. YORK. Yes, I do.

Mr. MAHON. Do you feel that the country has done well to back this concept aggressively?

Dr. YORK. I think the answer is "Yes," if I understand your question.

Mr. MAHON. Do you think we are pushing this program as hard as we should in view of the fact that apparently all of the major problems are solved and the weapon offers such unique possibilities?

Dr. YORK. From the point of view of development, first, my answer is yes. There is further development to be done and, first of all, they are testing the problem of communications, underwater launch and so on. In addition, I think it is very important to get on with the development of a follow-on version of POLARIS that would have a range of more than 2,000 miles.

I am in very close touch with Admiral Raborn, Admiral Hayward, and others on that matter.

What we are waiting for is the appropriate time when that can be initiated without interfering with the present program.

There is a great deal of heat on everybody to get this thing done and out to sea, so that we do not want, right now, to introduce this longer range program.

We want to do it as soon as we can.

It greatly increases the effectiveness of POLARIS to get the range up to 2,000 or 2,500 miles.

Mr. MAHON. It seems to me that if I were concerned about the defense program of some opponent of the United States I would be deathly afraid of a weapon which offers as much possibility as the POLARIS does.

Dr. YORK. Yes, although it is a matter of comparison here. The POLARIS is especially useful in connection wih deterrents for the party that expects it may be struck first. If you knew that, if you knew that you were going to strike first, then it does not offer advantages over the land-based system, or, at least, I do not believe it does.

While it is pertinent to use your words "deathly afraid of this" those words can apply equally strongly, if not stronger, to land-based ICBM's in the Soviet's hands.

Mr. MAHON. We get into a very interesting field there of the security of these fixed missiles.

Dr. YORK. For the fellow who strikes first, the security does not matter.

NEED FOR INCREASE IN NUMBER OF POLARIS SUBMARINES

Mr. MAHON. Do you feel that, except for budgetary limitations, this country should go along with the idea that Admiral Burke suggested some time ago, that we increase, beyond the budget, the number of POLARIS submarines?

Dr. YORK. The Secretary of Defense is right now trying to work out with the Navy Department what should or might be done along in this line.

Mr. MAHON. Do you have any personal views as to what you would feel would be your duty if you were on this side of the table as a Representative of Congress?

Dr. YORK. Of course, these questions of deployment fall outside of the research and engineering area.

Mr. MAHON. I know.

Dr. YORK. On the other hand, I look favorably upon the POLARIS system.

Mr. MAHON. If you were in our shoes, so to speak, would you feel confident enough to go beyond the budget in order to get further strength in this field, especially since we have announced we would not launch an attack ourselves?

Dr. YORK. I am confident enough in the engineering aspect of POLARIS to be certain that it would work. Any further money would not, from that point of view, be wasted.

POLARIS will work well enough to do whatever the people in charge of deployment want to do.

EAGLE MISSILE SYSTEM

Mr. MAHON. How do you feel about the EAGLE missile? How do you feel about this concept of the EAGLE missile? Is it just another missile, or does it have exceptional possibilities?

Dr. YORK. It has capabilities that existing systems do not have, and it is a natural development of the art in air-to-air missilery. I am

confident that something with the specifications the Navy desires for the EAGLE can be developed.

Mr. MAHON. You would use a relatively slow airplane, but the EAGLE missile would have the real capabilities?

Dr. YORK. The so-called Missileer airplane, which is a relatively slow airplane, is in a way a separate idea. You can distinguish between the two. The EAGLE is this very long-range intercept system. That means that not only the missile has to be long range but the fire control, detection, and everything else. The Missileer is one concept of how to use the EAGLE missile and involves an idea of having an airplane which, in terms of speed, is of low performance but which would have high endurance—that is, long flight time. The Navy concept is that this high endurance, low performance aircraft would circle the fleet or more or less stay in the center of the fleet and be up there and ready to fire at any time and fire for a long distance.

These are two somewhat separate but obviously related concepts.

Mr. FLOOD. Mr. Chairman.

Mr. MAHON. Mr. Flood.

Mr. FLOOD. The most desirable combination would be a certain type of seaplane, nuclear-powered, with the EAGLE; is that right?

Dr. YORK. Not necessarily, because if you can get a long enough time for the Missileer—and the Navy would like to have, say, 7 hours for the time that it can stay on station—that is getting long enough so that if you made it a lot longer or even removed the requirement altogether by going to a nuclear seaplane, it would not make a lot of difference. It would be better, but whether it would be enough better to make all the other complications worthwhile, I am not so sure.

Mr. MAHON. For this airplane, the so-called low performance airplane, to be used with the missile would you have to design an entirely new airplane, engine, et cetera?

Dr. YORK. You might be able to take an existing engine but, basically, the answer is yes, it would be a new airplane.

On the other hand, the EAGLE could be used with existing airplanes. It is simply that the Navy's concept does involve a new airplane.

Mr. MAHON. What is your estimate of the total cost of the development of the EAGLE system, including the new aircraft, new engine, probably new guidance, and everything? Is it a multimillion-dollar project?

Dr. YORK. It is up in there. It is a billion-dollar class sort of thing, I am sure.

Mr. FLOOD. Mr. Chairman, you should point out there is in the Navy request funds to develop this airplane, to develop the engine for this airplane. The Navy takes the position that they do not have such an airplane, carrier-based or anything else, and there is money in this budget to create an engine and airframe and everything else.

Dr. YORK. There is money requested for the missile and for a design competition for an airplane. The airplane is referred to as the Missileer and funds for both are in the Navy's 1961 budget.

AIR DEFENSE FOR THE FLEET

Mr. MAHON. Did you mean your statement to be significant with respect to the cost of providing air defense for the fleet?

Dr. YORK. What I was referring to there is that there are many approaches to defense of the fleet, and just a comment with regard to the fact that the Navy has also got an offensive function as well as just defending itself. We have to be careful that we do not spend all our resources defending the Navy, per se. That is what that refers to.

Mr. MAHON. You say,

> In providing air defense for the fleet, the point of diminishing returns sets in even sooner than it does with respect to continental air defense. Naval interceptors, air-to-air missiles, surface-to-air missiles such as TALOS, TERRIER, and TARTAR, and a great host of complex electronic detection, control, and communications equipment are required to defend the fleet from air attack. If allowed to develop unchecked, the cost of these programs might easily rise to a level between $1½ to $2 billion annually. Considering the relatively small size of the striking force they are intended to protect, this would seem to be a disproportionate share of our resources to invest in a purely defensive function.

Dr. YORK. As opposed to the other things you want the Navy to do.

Mr. MAHON. What are the other things we want the Navy to do?

Dr. YORK. We want the Navy to be able to participate in limited war.

Mr. SHEPPARD. Why limited?

Dr. YORK. Any kind.

Mr. SHEPPARD. Pardon the interjection. I do not want to belabor any issue, but, frankly, the testimony is cluttered up with limited, limited, limited. I do not think that is the proper concept. I think the word "limited" is a bad situation, internationally speaking.

Dr. YORK. Limited war means to me you are contrasting it with all-out, global, nuclear war.

Mr. MAHON. Since a great portion of an aircraft carrier's power is devoted to self-defense, do you intimate that you feel that the carrier is moving toward a time when it will have much less significance than it has now?

Dr. YORK. No, but one does have to take care about emphasizing or, rather, about not overemphasizing defense to the point where that is all you are doing. I am certain such care will be taken and that the carrier will be an important part of the force for the foreseeable future.

CARRIER VULNERABILITY TO SUBMARINES

Mr. MAHON. No doubt you have worked considerably in the field of antisubmarine warfare, your scientific people are working in this field. Is it thought that carriers could remain afloat in an ocean infested by hundreds of enemy submarines?

Dr. YORK. You have to ask for how long, more than if. If the area is infested by hundreds of submarines, there will be some rate of decay of the fleet. I do not know what it will be, but eventually they will be able to get it all.

The question is how long? I do not know how long, but long enough for it to perform, long enough, probably, for it to be able to perform most of its mission in connection with any strategic or tactical purpose, long enough to get its airplanes off. In connection with limited war against an unsophisticated enemy, it would be long enough to carry out all its objectives. It is the intermediate case of a long, protracted war against the Soviet Union where the fleet would disappear.

Mr. FLOOD. And most everything else.

Dr. YORK. And most everything else.

Mr. MAHON. Do you visualize a time when much of the naval operations may be below the surface?

Dr. YORK. Of course, more of the naval operation is going below the surface in connection with things like the POLARIS system. But I do visualize the carriers being an important part of our arsenal for as long as I can see. By that I mean 10 years. I do not mean I doubt they will be here after 10, but I have no idea.

Mr. MINSHALL. You would not go so far as to say we would need them 23 years from now?

Dr. YORK. My hunch is they will, but I cannot see that far. I do not know what the Soviets are going to be doing between now and then.

ANTISUBMARINE WARFARE

Mr. MAHON. You speak about undersea warfare. This is not a very romantic phase of warfare probably, at least in the eyes of many. Some of the members of this committee have felt that the Department of Defense has neglected antisubmarine warfare programs, that they have not pushed them hard enough, have not been as aggressive as they should have been, and that have more or less assumed there was no real answer to the threat involved in the submarine.

It seems to me that Admiral Burke was right last year when he said that the submarine threat was growing more rapidly than the know-how as to defeating the submarine, or words to that effect. What is your conclusion?

Dr. YORK. You mean that the threat is growing more rapidly than our knowledge of how to defend against it?

Mr. MAHON. Yes.

Dr. YORK. I do not really know, but I think that is probably true. That is true in quite a few fields of modern weaponry.

Mr. MAHON. Could we do more about this business of antisubmarine warfare than we are doing? Could we reasonably do more than we are doing? Last year we provided some funds above the budget and those funds are being used, I believe.

Dr. YORK. Yes, we could do more. In some of the peripheral things we are in fact doing more. I am having discussions with the Navy about possible still further extensions. By peripheral I mean oceanography. We are increasing the oceanography basic research effort.

Members of my staff are examining with the Navy the possibilities in hydrofoil boats and other new kinds of boats. Within the core of what is referred to as undersea warfare, weapons such as SUBROC, detection systems, all of that, the answer is, "Yes," it could be increased, and increased without waste of funds.

On the other hand, you can say that about almost anything we are doing, that it can be increased. We no longer have the luxury of choosing between good and bad programs or important versus unimportant programs; we have to choose between very important programs and pretty important programs. It is after making just such a wide variety of choices that we come up with what we have submitted.

Incidentally, my office and the Navy are in substantial agreement on this. It is not as if they wanted to do one thing and we wanted to do another.

Mr. MAHON. It seems you would feel that in the area of research and development might rest your greatest hope because you do not have a very good answer to the submarine threat.

Dr. YORK. No, not very good.

MINUTEMAN PROGRAM

Mr. MAHON. I would like to talk to you a little bit about the intercontinental ballistic missile program. Can you assure the committee that the MINUTEMAN will be operational and available for utilization in 1963?

Dr. YORK. I am personally quite confident of that. My personal belief is it is early 1963 rather than late. I think it will come through very nearly on schedule, but it is not far enough along to be sure. Considering how much is now known about all of the problems that have to be solved—the guidance, ground control equipment, solid propellants, things we have learned from other programs, and particularly the POLARIS program—there is no reason why it should not be available in 1963 if the program is run correctly.

Mr. MAHON. You stake your reputation more or less on the prophecy that the MINUTEMAN will be available for early 1963, or at least by 1963?

Dr. YORK. At least for 1963, I believe it will be. I am certain it can be. I believe the people who are actively running the program will do the right things.

Mr. MAHON. Let us assume that you may be in error here. What are you doing to insure against a miscalculation?

Dr. YORK. A miscalculation with respect to whether MINUTEMAN will be ready in 1963?

Mr. MAHON. Along about then.

Dr. YORK. There is not much more development work you can do. We have been in close touch with the Air Force Ballistic Missile Division about whether they needed more funds for that program. The statement is that they do not as far as development is concerned.

The other missiles, ATLAS and TITAN, will be available prior to that time. There is the B–52, with the HOUNDDOG, and there are the POLARIS boats with the POLARIS missiles on board, so that we are a long way from the situation where MINUTEMAN is the only thing we would have in 1963.

Mr. MAHON. My point is this: Would you not have a very marked gap in our program if that calculation proves to be faulty and you do not have the MINUTEMAN as planned?

Dr. YORK. You would not be as well off as you otherwise would.

Mr. MAHON. What should be done about that to insure against that condition?

Dr. YORK. From the development point of view, make sure that the other programs do come along, the ATLAS, TITAN, POLARIS, HOUNDDOG, and so on, and to assure to the extent you can that there is adequate warning to enable you to use the air fleet.

Mr. MAHON. There is some considerable argument that the B–58 ought to be accelerated beyond present plans as a weapon that would be available in quantity during that time.

Dr. YORK. You mean buy more?

Mr. MAHON. Yes, and maybe buy the proposed improved version. Do you have any opinions on that?

Dr. YORK. I defer to General White's views on what is the best thing to do there.

Mr. MAHON. You have told us, as others have, that you cannot move the MINUTEMAN program of research and development ahead. Present plans call for a one-source production line, I believe. Would this slow up the deployment of this missile?

Dr. YORK. Would having only one source slow it up?

Mr. MAHON. Yes.

Dr. YORK. No, not unless some catastrophe occurs in connection with this source.

Mr. MAHON. We were told that a decision must be made by December 1960 if we are to get a second source production line producing by the operational date. Are you familiar with this proposition and how do you feel about it?

Dr. YORK. Most of the discussions about a second source for MINUTEMAN have been related to the question of whether the actual production rate should be increased.

Mr. MAHON. Yes. Off the record.

(Discussion off the record.)

Mr. MAHON. The question is how fast do you want to go with production. That is not specifically in your field.

Dr. YORK. That is right, and it does come at a time when there already are substantial numbers of other forms of missiles.

INTERDISCIPLINARY RESEARCH

Mr. MAHON. On pages 5 and 22 of your statement you speak of interdisciplinary research. I am a little unsure of what you are speaking of.

Dr. YORK. You mean what that adjective means in connection with this?

Mr. MAHON. Yes.

Dr. YORK. This is referring to the materials program and the interdisciplinary here means more than one field of science working simultaneously on a problem. It means chemists, physicists, metallurgists, and so on, carrying out a joint program of research rather than just research in metallurgy or just research in ceramics or just research in physics.

Mr. FLOOD. You use the term "discipline" as synonymous with a specific field of science?

Dr. YORK. Yes, sir.

DISTRIBUTION OF RESEARCH, DEVELOPMENT, TEST, AND EVALUATION PROJECTS

Mr. MAHON. Dr. York, on page 6 of your statement you stated that the research, development, test, and evaluation program consists of approximately 2,000 projects which represent some 15,000 tasks. You

then say that approximately 72 percent of the program is accomplished by contract with industrial organizations.

Dr. YORK. Yes.

Mr. MAHON. Seven percent by educational and other nonprofit institutions, 21 percent by Federal Government installations. Do your percentages refer to dollars or to numbers of projects?

Dr. YORK. Dollars.

IMPROVEMENTS OF B–52

Mr. MAHON. You discuss improvements of the B–52. Will you give the committee a tabulation showing cost of these modifications to the B–52 in fiscal years 1959, 1960, and 1961. I doubt that you would have it with you.

Dr. YORK. I do not.

Mr. MAHON. I think it would be interesting if you could provide us with an indication of these costs. It seems so much of our cost goes into the upgrading and the modification and improvement of these weapon systems.

Dr. YORK. It is true that some does. On the other hand, in a system like this, the B–52 is the backbone of our deterrent and will continus to be for some years. Improvements in that are, I think, a very good and sound investment.

(The information requested follows:)

(Total cost of the B–52 modification program for fiscal years 1959, 1960, and 1961 is as follows:)

Fiscal year:	*Amount (in millions)*
1959	$ 53.1
1960	88.8
1961	181.5

Class V modifications and major representative class IV modifications for each fiscal year are shown below.

B–52 CLASS V AND MAJOR CLASS IV MODIFICATION PROGRAM FISCAL YEAR 1959

(1) APX–25 identifies friendly aircraft.
(2) ARA–25 airborne radio direction finder.
(3) ARN–21 airborne radio navigation system.
(4) Special weapon capability change.
(5) Provide GAM–72 capability.
(6) Automatic arming device for special weapons.
(7) Special weapon clip-in capability.
(8) Provide GAM–77 carrying capability.
(9) Provide low altitude combat capability.
(10) Modification of ejection seats.
(11) Revised air bleed manifold.
(12) Modify water injection pumps.
(13) Hermetically sealed bomb door switches.
(14) Heat exchanges between fuel tanks and engine.
(15) Modify 50 caliber ammunition hoist.
(16) Remote flight attitude indicator.
(17) MA–5 remote attitude indicating system.
(18) Install external flap on upper aft hatches.
(19) Install shock mounted wing and tail navigation lights.
(20) Wing leading edge reinforcement.

B–52 CLASS V AND MAJOR CLASS IV MODIFICATION PROGRAM FISCAL YEAR 1960

(1) APX–25 identifies friendly aircraft.
(2) ARN–21 navigation system.
(3) ARA–25 airborne direction finder.
(4) ARS–54 search radar.
(5) Special weapon capability change.
(6) Relocate ECM controls.
(7) Increase ECM jamming transmitters.
(8) GAM–72 QUAIL.
(9) Automatic arming device for special weapons.
(10) Special weapon clip-in capability.
(11) GAM–77 HOUND DOG.
(12) Low level capability.
(13) Change in auto pilot controller and amplifier.
(14) Install VGH recording and playback equipment.
(15) Modification of ejection seats.
(16) Improved air filter check valve.
(17) Escape latch change.
(18) Revising air bleed manifold.
(19) Heat exchanger in fuel tanks.
(20) MA–4 remote altitude indicating system.
(21) External flap change.
(22) Stabilizer trim cutout switches.
(23) Modify water injection pump.
(24) Wing leading edge reinforcement.
(25) Reinforce wing flap tracks.
(26) Nonicing fuel control valves.
(27) Remote counter for APR tuner.
(28) Improve thermal curtains.
(29) Modify water injection valves.
(30) Revise engine fire detector system.
(31) Replace shock cylinder drag chute mechanism.
(32) Replace check valve on boost pump.

B–52 CLASS V AND MAJOR CLASS IV MODIFICATION PROGRAM, FISCAL YEAR 1961

(1) Relocate ECM controls.
(2) ECM jamming transmitters.
(3) GAM–72 QUAIL decoy.
(4) Automatic bomb arming device.
(5) Special weapon clip-in capability.
(6) GAM–77 HOUND DOG.
(7) Low level capability.
(8) Emergency ECM package.
(9) Alternate ECM package.
(10) Inboard flap modification.
(11) Install VGH recorders.
(12) Eliminate wing tank fuel vent spillage.
(13) Rework station 1655 bulkhead.
(14) Rework upper and lower wing panel.
(15) Structural mod to empennage.

NUCLEAR-POWERED AIRCRAFT PROGRAM

Mr. MAHON. Can you tell us of any meaningful and significant improvements in the nuclear-powered aircraft program? We have been talking about that for years. We seem to get nowhere particularly.

Dr. YORK. New technical developments?

Mr. MAHON. Yes.

Dr. YORK. I do not know how far back you want to go. The program is one in which there has been steady progress over the last year. In connection with the direct air cycle, which is being done by

General Electric Co., they have made progress with regard to their ceramic reactor and in such matters as coatings. They have learned considerably more about coatings, how to make the ceramic elements.

They have made some progress on their big air source, which in this case actually happens to be a turbine engine that could be used here. There are not any breakthroughs.

Mr. MAHON. No real spectacular progress?

Dr. YORK. No. In connection with the indirect cycle, it is the same picture. More has been learned about how to handle metals. The use of the metal is a key issue here, the question of how to coat it to make it oxidationproof, how to alloy it to do the same thing, how to build the parts. There is steady progress but no phenomenal breakthrough.

Mr. MAHON. When is the nuclear aircraft going to fly?

Dr. YORK. The way we have the program laid out at the present time, not before 1965, and I do not say it will fly then, but not before 1965.

Mr. MAHON. In other words, it is a little bit fuzzy as to just when we may have it?

Dr. YORK. That is right; we do not have a powerplant.

Mr. SIKES. Will the Chairman yield?

Mr. MAHON. Yes.

Mr. SIKES. I was interested in what you said about not having the powerplant. I recall a statement made by one individual at a meeting in the last few weeks in which he said we do have small powerplants which can be used to produce nuclear-powered planes more rapidly and that it is a matter of policy rather than lack of know-how that has slowed our nuclear-powered aircraft progress. Are you familiar with that situation?

Dr. YORK. I am not familiar with that particular statement. I am familiar with that particular argument.

Mr. SIKES. Will you comment on the argument that we do have small nuclear plants which are capable of being converted for use in propelling nuclear aircraft?

Dr. YORK. I do not know what was meant by small in this case. There was an issue last summer with regard to this question. Considerable effort was put into that problem of: What is the right thing to do? This was in my office. At that time there was no powerplant. There were some fuel element developments, however. The nuclear reactor is a complex of what are called fuel elements. There had been some fuel element development that had gone in the direction of possibly producing a reactor, but this reactor would have what, at best, could be called very marginal performance and, in our view, little or no growth potential.

In our view, which other people regard as too extreme, to be sure, but in our view the program had been plagued in the past by attempts to find a shortcut to flying soon where flight was defined as getting off the ground for any arbitrarily short time. It was our view that this approach to the problem was one of the contributing factors to having delayed it this long and that there was no time like the present to start doing it right, which was to get on with the development of a powerplant that could have growth potential to something that could be useful.

Mr. FLOOD. Is it the fable of the tortoise and the hare, that sort of thing?

Dr. YORK. I do not know. I do not see the analogy.

Mr. FLOOD. I am not sure I do either, but it seemed to be a good idea at the moment.

Mr. SIKES. There is definitely the feeling, the rather general feeling, I think, that we are fiddling while Rome burns—to switch to another expression—in the field of nuclear-powered aircraft, that we are not doing as much as we could and that we may be sacrificing something significant and important by not doing more. You do not seem to feel that is the case.

Dr. YORK. Well, it is like other things. We could do more.

Mr. SIKES. You do not think it is worthwhile to do more?

Dr. YORK. No; not stacked up against everything else. It is the largest program we have which is not directed toward a specific weapon system. This is the largest development program we have that has no specific weapon system goal. It is about $150 million a year between the Department of Defense and Atomic Energy Commission.

Mr. SIKES. Might it not be done at less cost if we were to push ahead and get it finished rather than proceed slowly over a number of years?

Dr. YORK. Well, yes, but you cannot turn the clock back. I think 5 years ago if people had put their minds to the problem and said, let's get a good powerplant and then we will fly, we would have saved quite a bit of time and money.

Mr. SIKES. Thank you.

NUCLEAR-POWERED ROCKET

Mr. MAHON. There has recently been some discussion of development of a nuclear-powered rocket. Is the Department of Defense making any contribution toward this project?

Dr. YORK. No. We did in years past but that was transferred to NASA about a year or a year and a half ago.

Mr. MAHON. You are not in that field directly yourself?

Dr. YORK. Not in the nuclear-rocket field.

Mr. MAHON. Mr. Flood just handed me a New York Times story as follows: "Nuclear rocket gets more funds. AEC cuts its own outlay to offset trims in project made by Budget Bureau." That, of course, is an AEC project.

Dr. YORK. It is an AEC and NASA project.

Mr. MAHON. Do you believe that this nuclear-rocket program is highly significant from a military standpoint?

Dr. YORK. It is like any other field of technology. It may very well turn out to be highly significant. There is no obvious application of it in connection with the solving of military problems.

On the other hand, it is a field of technology where, after you know more about it, it may very well turn out to have major application. There is no obvious application of it in the military field.

Mr. MAHON. Mr. Flood also handed me another statement here in view of the fact that I am undertaking to ask a number of questions

for the committee. This is a story out of Hamburg, Germany, of March 4. I quote a portion of it:

Swedish rocket expert and self-confessed spy said today Russia has produced a revolutionary nuclear-chemical rocket capable of traveling 18,000 miles an hour.

Have you read this story?

Dr. YORK. No.

Mr. MAHON. It is rather an interesting story and I call it to your attention for the purpose of trying to get a further statement from you, if you could give it, with respect to the possibilities of the nuclear-powered rocket.

Dr. YORK. A nuclear rocket can probably be made to work.

Mr. FLOOD. May I add the story, of course, refers to a Russian invention. It emanates from Hamburg as the result of the appearance there from East Germany of a Swedish allegedly technical, scientific double agent or triple agent and it is a UPI story.

I first had the information from Paris 24 hours before this appeared in UPI in the United States. I asked my friends to give me a translation of the French story, plus our own UPI American story. This is the translation and UPI American story. The basis of the operation is the utilization of hydrogen in the mechanism ignited by oxygen for propulsion, et cetera, not particularly new but apparently you might look at the story.

Dr. YORK. I feel that a nuclear rocket can probably be built.

Mr. SIKES. Is there a place for it?

Dr. YORK. I believe the proper place for the nuclear rocket is in connection with use in applications where the objective is a very large change in velocity because the advantage of the nuclear rocket is that it has a higher specific impulse.

This means that the higher the velocity change you want to get and, in general, the higher the velocity change one wants to achieve, the more important high specific impulse becomes. For earth orbital purposes or for ballistic missile purposes it does not have much advantage over chemical rockets even potentially. Of course, it will certainly be a very complicated system.

Mr. MAHON. Will you make a little more clear what you had in mind?

Dr. YORK. I was making sort of some basic statements in connection with long-range rockets.

Mr. MAHON. And high impulses.

Dr. YORK. High specific impulse becomes more and more important as the total velocity change you want in the system becomes larger. To make an intercontinental missile you need a velocity of the order of 5 miles a second. To get to the moon you need a velocity of 7 miles per second. To get to Mars and back you need a velocity of 15 miles a second total velocity change throughout the course of the mission. At lower velocities the high specific impulse of the nuclear rocket is relatively of less importance than it is at the high velocity end. The size of the earth is such that for low orbit satellites or for intercontinental missiles you can do the job perfectly well with chemicals. If you want a round trip to Mars or something like that, then the high specific impulse of the nuclear rocket becomes of very great potential importance. So that the realm in which the

nuclear rocket offers potential value is in the realm of long distance space travel, round trips, and things of that sort rather than in the realm of earth satellites and intercontinental missiles.

Mr. FLOOD. Of course, there is this possibility, that as we have reduced the yield of a warhead of weapons from megatons to a fractional yield for tactical field weapons down to one infantryman, you can also reduce the yield of your thrust by nuclear power, and there might be considerable advantage in your low orbit if done by nuclear power.

Dr. YORK. The nuclear rocket people are working on a certain type involving what is called the heat exchanger.

Mr. FLOOD. In the area of which you are speaking?

Dr. YORK. You just pass hydrogen through passages in a block of graphite which has been made hot by means of nuclear reaction.

Mr. FLOOD. This system upon which this agent reports is pretty much the ignition of the hydrogen in the nuclear mechanism by oxygen.

Dr. YORK. I do not understand the statement, the report, at all. The hydrogen-oxygen rocket is a chemical rocket and nuclear power has nothing to do with it.

Mr. MAHON. Let me suggest you look at the UPI story and tomorrow we can ask you about it again. That would be better.

Mr. SIKES. May I make one comment before we get too far away from Mr. Flood and his spies? I have noted through the years that I seem to learn more from Mr. Flood's spies than I do from Mr. Dulles' spies, and I am wondering if we are backing the wrong horse in the spy business.

Mr. FLOOD. I have offered them all these sources. They have them all.

Mr. MAHON. Mr. Secretary, we have before us a very real problem of trying to pick what horses to back, so to speak, in this field of defense. We put the taxpayer's dollar on the POLARIS in a rather big way. Of course, we had lots of encouragement and support. Otherwise we would not have done it. It looks like that is going to pay off. It is most important, since funds are not unlimited and we operate under budgetary ceilings, it is most important to put our money on the right project.

Dr. YORK. That is right; that is the burden of my job, too.

CANCELLATION OF F–108

Mr. MAHON. Yes. You came along here, you and others—principally the Air Force, of course—and asked us to put a few hundred million, if not a few billion, on the F–108 long-range fighter. Even last year at this time the Department of Defense was up here urging us to provide funds for the F–108, including the Secretary of Defense himself, and we gave the Department of Defense about $160 million additional for the F–108. Then, after the adjournment of Congress later in the same year, however, it was cancelled out at great loss to the country. Do you think that was a wise thing to do?

Dr. YORK. Cancellation of the F–108?

Mr. MAHON. Yes.

Dr. YORK. Yes, considering everything, I think it was appropriate to cancel.

Mr. MAHON. Were you consulted in any way?

Dr. YORK. I was involved because it was a development program.

Mr. MAHON. You did not oppose it? Rather, you advocated it under the circumstances?

Dr. YORK. Advocated what—cancellation?

Mr. MAHON. Yes.

Dr. YORK. I ended up advocating it. I spent a lot of time discussing the F–108 problem with General White and with Dr. Charyk, who at that time was Assistant Secretary of the Air Force for R. & D.

Mr. MINSHALL. If the Chairman will yield, what were his basic reasons for advocating the abolition of the F–108?

Dr. YORK. Really, I was agreeing with the Air Force's approach to the problem because there was no strictly technical reason for abandoning the F–108. That is to say, from the technical point of view of view there was no substantial doubt but what it could be built. It was primarily an operational or military problem, and the Air Force was faced with the question of what to do with its resources. It was really their judgment as to how the F–108 stacked up with other things they had to do and with how important defense against manned bombers was at the time period when this could become available. In other words, I think it is more nearly correct to say that I concurred in the cancellation of the F–108 rather than proposed it.

Mr. MINSHALL. Would your decision be the same today?

Dr. YORK. Yes, if General White felt the same today.

Mr. MINSHALL. Even in view of all the BOMARC failures, your decision would be the same?

Dr. YORK. I think manned interceptors are and will remain an important part of the manned bomber defense. But that is not to say that this particular weapon system is essential. There are other possible improvements on other aircraft for accomplishing the same job.

In other words, my view is that manned interceptors are important and that is really independent of the BOMARC test program, but that the F–108 is not the best approach to this problem. I felt that before the BOMARC was doing what it is doing.

Mr. FLOOD. The next step they have to make with manned aircraft is to breach the thermal barrier and they thought they could breach it with the B–70 and the F–108.

Dr. YORK. From a technical point of view, that was a consideration. I felt we should go ahead with some mach–3 aircraft. The question was which one. Now that question is more of a military question than it is a strictly technical question.

ADEQUACY OF B–70 PROGRAM IN BUDGET

Mr. MAHON. There are several of these weapon systems we want to discuss with you. Let us get into the discussion of the B–70 here for the remainder of the afternoon, probably.

This is a big package involving several billion dollars. Somebody over in the Department of Defense has tailored this thing down to the point where the Air Force is very unhappy about it, at least many people in the Air Force are very unhappy about it. I am sure the Secretary and Chief of Staff support the budget program within certain limitations. It seems to me to be a very serious question as to whether or not we are doing the right thing about the B–70.

How do you justify not going forward with a weapon system in connection with the development of the B–70? Just to build two of these airplanes is certainly not a very ambitious approach.

Dr. YORK. There are two questions with respect to weapon systems versus experimental approach. One of them has to do with building only two aircraft. The significance of that is that the size of the manufacturing establishment you are building up is not as big as you would build up if you knew you were going into a large-scale production program.

There is a second aspect which has to do with subsystems, how many of the electronic subsystems, and so on, should you be working on. There in that field in my discussions with the Air Force we have felt that we should carry some of them on. We have done some reprograming this year in order to carry on in particular what is called the bomb-navigation system. We probably will do some reprograming next year for the same thing.

If we plan this program correctly with respect to these subsystems, what we will be doing is carrying on a development program that still can lead to a B–70 weapon system but later than the original program would have—later by several years.

We are also, by doing this, keeping open the option of being able to go ahead with an optimum procedure. What we are trying to do, in fact, is find the right program and right distribution of these funds so that we are in an optimum way maintaining an option for being able to go ahead if circumstances should change and indicate we could or should.

Mr. SHEPPARD. Will the gentleman yield?

Mr. MAHON. Yes.

Mr. SHEPPARD. Are you approaching it from the point, by getting the two, as it were, that you have an opportunity to iron out the bugs, using my language, and be more definite in your production line requirements as against going out and buying a multiplicity of them and then being confronted with an extensive modification program?

Dr. YORK. This approach, if done directly, leads to a better airplane at a later time.

Mr. SHEPPARD. At less money because you are not buying the total amount of them in the first place.

Dr. YORK. Probably less gross money, but people can argue the other way. I am inclined to agree with you, Mr. Sheppard, that it would be less gross money.

Mr. MAHON. Dr. York, it has been my observation that some people consider you to some extent as a hatchetman who trims down programs to keep them within certain budget limitations.

Dr. YORK. I did not trim that one down.

Mr. MAHON. You did not have anything to do with trimming this one down?

Dr. YORK. I was in all discussions involved in it. It was not my proposal, however.

Mr. MAHON. Did you have a proposal in connection with this?

Dr. YORK. Originally, my views were to back the program more or less along the Air Force lines. Originally, I supported the Air Force point of view.

Mr. MAHON. You supported the Air Force point of view for a weapon system to go along with the development of the airplane itself?

Dr. YORK. Well, with the complete weapon, not quite the complete weapon system.

Mr. MAHON. It seems to me you are in a very peculiar and important and strategic position. If you capitulate always to fiscal considerations, maybe you do not serve your most useful purpose.

Dr. YORK. That would be true if I capitulated always to fiscal considerations, but I do not think I do.

Mr. SHEPPARD. If the gentleman will yield, were you the recipient of the same thing that we understand other Government departments were, that you had a certain budget ceiling and that to the degree to which you function you made certain recommendations within that limit; is that right or not?

Dr. YORK. That is a question better addressed to the Secretary because I do not know what he was told, precisely, but as he said here, his guidance to the departments was to submit two budgets, a basic budget and an addendum budget.

Whatever people might have said, I used as a working assumption that the budget for fiscal 1961 was not going to be very different from the budget for 1960. Remember that a billion dollars is only 2½ percent, and 2½ percent difference is not a very big difference. So, without being told, it seemed clear that we were going to be constant within 5 percent. That was a working assumption and I think it is a good one.

Mr. MAHON. You spoke a moment ago, I believe, of reprograming funds.

Dr. YORK. Yes, sir.

Mr. MAHON. I had understood this budget was very tight. How are you going to reprogram funds?

Dr. YORK. Yes; but in research or development there are always changes in both directions. I cannot give you a good figure, but it has historically been so that a considerable fraction of the R.D.T. & E. budget is reprogramed during the course of the year.

Mr. FLOOD. Was that not your position? You are the R. & D. man and you were confronted by the Air Force with a question: We want a bomber which must be able to breach the thermal barrier. You are confronted with the problem of aerodynamics, of a cruise flight at mach 3, for a structural capacity which has never been met before. You have the matter of air cooling; you have integrity of the airframe under all these conditions. They said to you, "Can you build such a beast?" You said, "I think we can." They had to decide whether it would be a fighter or bomber, not you.

Dr. YORK. That is the matter between the B–70 and the F–108.

Mr. FLOOD. That was not your decision.

Dr. YORK. That is right. Within the program the matter is one of how urgent is it from a military operations point of view. As far as my office is concerned, our statement was that the B–70 is a technically sound program.

Someone else, really, between General White, the Chiefs of Staff, and the Secretary of Defense had the problem of how urgent it is,

what time period must you have it in, do you want this airplane in 1965 or in 1967 or in 1968? It would be a somewhat better airplane, as we discussed earlier.

Now, this is a fairly drastic change. The funds for this program have obviously been changed quite drastically. That means that we have to give careful consideration to just what is the right way to carry out the program at this new level. We have in discussions with the Air Force developed the position that some of the sub systems should be carried out, in particular the bomb-navigation system. So we have determined and it has been agreed that, in addition to the two aircraft and engine sets of components, we will carry out the development of a bomb-navigation system.

Mr. FORD. Will you yield?

Mr. MAHON. Yes.

Mr. FORD. As you indicated, Dr. York, there were two problems: (1) Our technical ability to develop the aircraft, and (2) the urgency of having this weapon system in our system at a certain time period.

Your job was to evaluate only the former, not the latter; is that right?

Dr. YORK. That is right. You inevitably get mixed up in the discussions of the latter.

Mr. FORD. But your prime responsibility is with respect to the former?

Dr. YORK. Yes.

Mr. FORD. Do you feel that the technical problems are surmountable

Dr. YORK. Yes. The airplane has some bad features. It probably will inevitably have a very large radar cross section and a very large infrared emission, which are negative factors; but we do not believe these are overwhelming negative factors.

Mr. FORD. Under the original schedule when would the first aircraft fly?

Dr. YORK. I would have to check on that. I think it was 1963 or 1964.

Mr. FORD. Is there any significant difference on that point between the old program and the present one?

Dr. YORK. There may be a small difference, 6 months to a year, that sort of thing.

Mr. FORD. You infer in your statement here that within the next year you will be more certain of solving these technical problems. If those problems are resolved, would your recommendation be that we ought to push ahead on the larger program at that point?

Dr. YORK. It would be that we could push ahead on the larger program. I do not know. I would have to see what the year turned up.

Mr. FORD. Are these subparts of the overall program vitally important to pursue this year as far as the overall program is concerned?

Dr. YORK. I think probably in the case of the bomb-navigation system that is true.

Mr. FORD. Is this a revolutionary development in bomb-navigation systems?

Dr. YORK. It represents substantial progress in that field. That is necessary for an airplane of this speed.

Mr. FLOOD. You have no doubt that the answer to Mr. Ford's question is, yes, do you, no intelligent doubt?

Dr. YORK. No. My answer to that is "Yes." The only reason for having any doubt or any possible doubt is the question that this is now a fairly long-term program and is now the necessary time to start out?

Mr. FLOOD. It is not a reasonable doubt under all the circumstances?

Dr. YORK. I do not doubt it myself.

Mr. FORD. We are pursuing that aspect in fiscal 1960 and 1961?

Dr. YORK. In fiscal 1960, not at the original rate.

Mr. FORD. If a year from now we proceeded with the aircraft program, would we be in step with the bomb-navigation phase?

Dr. YORK. That is essentially our objective, to try and have everything in step so that if a year from now or 2 years from now you did decide to go all out, these essential things would all be in phase with each other.

Mr. OSTERTAG. Will the gentleman yield?

Mr. MAHON. Yes.

Mr. OSTERTAG. Dr. York, in your statement you also say this raises a serious question as to whether the very costly effort needed to complete the development of this aircraft system is justified in view of the alternative strategic delivery systems available at that time.

I take it that means that by virtue of missile development and other weapon developments by that time there is a serious question as to whether this would ever be needed.

Dr. YORK. That is right. That list of things is essentially what the Secretary and others had in mind when they removed essentially the crash nature of this development.

Mr. FLOOD. Read the next paragraph, which gives a number of reasons why it should be otherwise, why it is important.

Dr. YORK. That is a brief list of things people considered. When you stacked them all up where people came out was we ought to keep the development going, but we ought not to have it on a crash basis.

Mr. MAHON. Do you have some doubt as to the navigation system of a bomber that goes mach 3?

Dr. YORK. No doubt that it can be done, but it is a difficult problem.

Mr. MAHON. Explain that.

Dr. YORK. You cannot use any of the classical methods of navigation. The airplane is too far away from other sources of position information, and it is going too fast and too high in order for the pilot to do much of a job of looking out the window to see where he is.

What you have to do is develop a modern system of navigation with all of the kinds of aids you can cook up, such as stellar fixes, inertial components, ground radar contacts, things of that sort. If you drop a bomb from an airplane at 70,000 feet going mach 3, it does not fall very near to the point of release. You have to use the most modern techniques with regard to that.

Mr. NORRELL. Mr. Chairman.

Mr. MAHON. Mr. Norrell.

Mr. NORRELL. Do you believe, Doctor, that our capabilities are stronger or weaker than those of any other country in the world? I mean all told now, not just one thing.

Dr. YORK. Talking about overall and talking about right now, I think ours are probably stronger than anybody else's, but I am not really the right witness to answer that question.

Mr. NORRELL. That is your idea?

Dr. YORK. Yes.

Mr. MAHON. Thank you very much, gentlemen. We shall adjourn until 10 o'clock tomorrow morning.

THURSDAY, MARCH 10, 1960.

Mr. MAHON. We shall resume our hearing.

DEVELOPMENT COST OF EAGLE AND MISSILEER

Dr. York, during our session yesterday we discussed somewhat the EAGLE system, which includes the missile and the aircraft, which I believe is called the Missileer. I do not recall whether I asked you about the total cost of the development of the EAGLE system including the aircraft, the missile, and the new engine. I wish you would give that information.

Dr. YORK. I have an estimate here but I do not know how good it is. I would have to do considerable checking on that, Mr. Chairman.

Mr. MAHON. All right.

Dr. YORK. It is probably a billion-dollar program, at least.

Mr. MAHON. Do you not think it is more than that?

Dr. YORK. By the time you buy some; yes. The development would be about that.

Mr. MAHON. Make it clear for the record.

One of your criteria is the weighing of the ultimate cost against the ultimate value of the weapon, as I understand it.

Dr. YORK. We try and do that.

Mr. MAHON. That is the reason I was interested in that angle.

ABILITY OF BMEWS TO DETECT ICBM ATTACK

Mr. MAHON. I believe we talked yesterday about the BMEWS system through which we would expect to detect the approach of ballistic missiles. You made reference from time to time to a massive attack of ballistic missiles. Did you mean to imply you could not probably detect one ballistic missile? What was the idea?

Dr. YORK. The BMEWS system is not very good against one missile ever, and especially in the early days of the system it is even less good against one than its ultimate capability. Ultimately, the problem is one of false alarms, spurious signals, and possibly even missing one.

In the immediate future the problem with one missile is that we are only going to have one station in place this year, and there are trapectories connecting parts of the Soviet Union with parts of the United States that could avoid that one station even if the one station were perfect. But even ultimately the false alarm problem means that while you might be able to detect one, you would not know for sure whether it was a missile or something accidental. Therefore, it is really best considered as a system for detecting a raid rather than one marauder.

Mr. MAHON. Of course, if you had only one ballistic missile fired at you, by the time it hit, you would have a warning.

Dr. YORK. You would have plenty of warning for succeeding missiles.

Mr. MAHON. I assume it would be the opinion of the officials of the Defense Department that no one would launch anything other than a massive attack of intercontinental missiles.

Dr. YORK. Certainly not deliberately.

Mr. MAHON. How will you be able to make sure, really, that you have detected an actual attack in quantity of ICBM's?

Dr. YORK. Being sure in this case is really relative. I personnally doubt you ever will be sure enough so that you would be willing to launch your missiles on warning from BMEWS. But you will be sure enough to be able to take action such as to make use of the ground alert posture and to get aircraft off and do all other things which are of a recallable nature.

What you are going to have to go by is this: The information will be available in the United States at Omaha and Colorado Springs and elsewhere as to how many signals suddenly showed up on BMEWS, how many missiles did it think it saw. If this number is some large number—I do not know what it would be, 20, 50, 100, 200—it is not likely that this number would be from some accidental or spurious cause. You can develop sufficient assurance in the system so that you would do everything short of an unrecallable commitment, short of actually launching missiles.

Mr. MAHON. In other words, I take it that you are saying the chances are in the event our BMEWS thought it saw a massive ICBM attack coming, we would not actually launch our ICBM's prior to the time we were actually hit by the ICBM's.

Dr. YORK. Mr. Chairman, of course, this is something which is the responsibiilty, and a very major responsibility, of the President, the Secretary and the Joint Chiefs. They have to make rules for this particular kind of event. I am really only giving you my own personal and rather unofficial judgment. This is the highest order of operational problem and is the responsibility of the operational people.

Mr. MAHON. You can speak from a scientific standpoint as to the degree of reliance we could afford to put on this. It would be the greatest tragedy of all time, probably, if we should through miscalculation, launch an ICBM strike when actually we were not under attack.

Dr. YORK. Yes. My input to the problem is to tell people that, in my judgment, this is an electronic device and there is not any way of really making it foolproof, and the operational planning for the use of this data should take into account that it cannot be made absolutely foolproof. There is no way to check the system out. There is no way to practice with the system.

Mr. MAHON. So you could take certain action such as getting your bombers off the ground and things of that kind, but you would have to be dead sure before you could afford to launch your counterattack missiles.

Dr. YORK. That is my very definite personal view.

Mr. FLOOD. If the gentleman will yield, what is the great significance? How is your position changed materially if what you say to Mr. Mahon is true about BMEWS? Why is there any material difference of MIDAS compared to BMEWS? Certainly, 15 minutes more makes no difference. If what you have just said about BMEWS is true, what difference is 15 minutes more, all things being equal?

Dr. YORK. There are two differences between MIDAS and BMEWS.

Mr. FLOOD. I know what the differences are between MIDAS and BMEWS, but what is the net result of difference?

Dr. YORK. I was going to put it in terms of results. In the first place, it is an extra 15 minutes.

Mr. FLOOD. That we know.

Dr. YORK. You can also say that it is twice as long.

Mr. FLOOD. That is exactly right.

Dr. YORK. Now, there is another difference.

Mr. FLOOD. If what you just said to Mr. Mahon about BMEWS is true, that first fact does not impress me at all.

Dr. YORK. There is a second difference, which I would like to mention. The first one does impress me.

Mr. FLOOD. Insofar as launching missiles is concerned?

Dr. YORK. No; but because of its value to the security of the United States.

Mr. FLOOD. For the purpose of launching missiles?

Dr. YORK. No; for the purpose of launching aircraft on ground alert and for the purpose of getting ready to launch missiles.

Mr. FLOOD. Getting ready to launch?

Dr. YORK. Getting ready to launch missiles.

Mr. FLOOD. At what point do you decide and under what circumstances do you decide? MIDAS gives you a warning of 30 minutes as a result of which you get ready to launch missiles?

Dr. YORK. Yes. Getting ready involves both tactical and administrative aspects. Getting ready to launch missiles means you have to locate the people who are authorized to press the button and to get the communications circuits opened, and so on.

I look on this 30 minutes as having a technical aspect which enables you to get your aircraft off, but it also is administrative leadtime. It is the last 30 minutes during which you may be able to ever locate the people who are responsible for the decision.

Mr. FLOOD. Certainly, 30 minutes is not much. When you say to somebody, "I will be back in a half hour," that 30 minutes assumes great significance in the life of man if what you are saying is so; does it not? "Out to lunch, be back in 30 minutes."

Dr. YORK. I think it is important to have as much time as you can.

Mr. FLOOD. What is the second point?

Dr. YORK. The second is coverage. The BMEWS that we are now putting in is for use only in connection with missiles coming the short way over the Pole. MIDAS, in principle, has geographic flexibility and can detect launchings anywhere in the world, including the hypothetical possibility of a launching in the Soviet Union where the rocket is designed to go around the other way.

Mr. FLOOD. Is this operation of MIDAS and perhaps BMEWS, too, more particularly BMEWS, something that you long-haired fellows decided you have to do to keep people like Mahon off your neck, to show you are really doing something, or do you really mean it?

Dr. YORK. We really mean it. It is something which the technical people have done in concert with the operational people. The North American Defense Command regards warning as its highest priority requirement. The technical people have contributed the information with regard to what they thought could be done for judgment by the operational people as to whether that was what was wanted.

With respect to MIDAS, I would like to say now that it is an especially difficult program. I do not concur in the estimates on dates that one often hears from the people in the program.

Mr. FLOOD. You made that clear before.

Dr. YORK. MIDAS, I believe, unless we have remarkable good luck, is ——— system. But it is designed to solve a permanent problem. There are always going to be rockets from here on into the future.

Mr. THOMSON. Will the gentleman yield for one question there?

Mr. MAHON. Yes.

Mr. THOMSON. You say that in you best estimate it is a ——— realization?

Dr. YORK. Of an operational system.

Mr. THOMSON. We had the first flight here just a few weeks ago that failed, did we not? Or it may have been a few days ago.

Dr. YORK. Yes.

Mr. THOMSON. I have been told 1961 operational.

Dr. YORK. I know. There is no claim from responsible sources for 1961. There are claims in responsible quarters, though, for about ——— but I do not believe it, is what I am saying.

Mr. THOMSON. Do you have any other reconnaissance satellite program other than MIDAS that might offer us an intelligence reconnaissance capability before that?

Dr. YORK. Yes, but that is rather different from warning. We have the photographic reconnaissance satellites, but these are for general intelligence. These are to find out what is going on and what is being built.

Mr. THOMSON. Where some of their bases might be that we do not know anything about now?

Dr. YORK. Yes; these are not for operational warning.

Mr. FLOOD. You have always maintained that. You have never been an early bird on this.

Dr. YORK. No.

VALUE OF WARNING TIME

Mr. MAHON. Dr. York, we talk about 15 minutes' warning and 30 minutes' warning. You and I know that unless some very special technique should be worked out between the President and the people who would actually fire these missiles, you could not get together and have a meeting and decide what to do in 15 or 30 minutes.

Are we kidding ourselves when we talk about this warning of 15 and 30 minutes? Are we putting our heads in the sand? Are we being completely unrealistic? It worries me that we seem to place so much significance on 15 or 30 minutes. I realize this is important within

certain areas, but I do not know whether it is as important as we tend to make it.

Dr. YORK. By these certain areas, were you including such as exercising the ground alert, making use of ground alert? For the next few years at least the SAC aircraft and, therefore, the ground alert are the most important components by far in our strategic deterrent. However long it takes to make the necessary decisions, this gives you an extra half hour to make them in.

Mr. MAHON. Of course, you could get the airplanes off the ground or begin to get them off the ground and do all those kinds of things immediately when you get any kind of alarm, false or otherwise, if you determine to do so; but if you are going to bring to bear your ICBM capability, that is something you have to consider with the greatest of seriousness because they are irretrievable once you launch them. I do not see much hope that you are going to be able to launch ICBM's prior to the time you are actually hit by the opponent.

Dr. YORK. That is right. That is why we are so interested in measures to enable the ICBM's to ride out a first attack. The first such measures that are being applied are hardening in connection with the land-based missiles and mobility and concealment in connection with the POLARIS. Down the road, as you know, we will also be applying the mobility concept to land missiles, the MINUTEMAN.

Mr. MAHON. Your answer seems to be reasonable to me.

TECHNICAL PROBLEMS IN NIKE-ZEUS PROGRAM

I would like to go to the NIKE-ZEUS. You do not seem to have much confidence in the so-called NIKE-ZEUS, and yet some of the people in the Army seem to be as sure of the success of this system as they are that the night will follow the day. Why all this skepticism on the part of a man in your responsible position?

Dr. YORK. The ZEUS is an extremely expensive system if it were deployed, designed for certain objectives. These objectives are either of two extreme types with possibly some combination. They can be used to defend the deterrent or they can be used to defend population or, of course, they can be used in some combination.

So one of the things that goes into the present decision is: How effective is it in doing either of those things, either considering just it by itself, how effective is it without reference to what other ways are there of doing the same thing? The other way of looking at it is: How effective is it relative to other possible procedures?

With regard to the internal question— how is ZEUS without reference to other means of protection—this question is primarily a technical one and involves trying to form some sort of judgment about how well it might work, how well it could be expected to work in a realistic environment. By realistic environment, we have a number of things in mind.

(Discussion off the record.)

The way the ZEUS decision is made is that we advised the Chiefs in detail, we spend an hour or so discusinsg this and briefing the Chiefs on our views with regard to these uncertainties.

The Chiefs, then, taking these technical views of ours and then weighing the usual problem of all else, there is to do with the defense resources and, second, what are the other ways of accomplishing the

same objectives of ZEUS—namely, taking the two simple cases of protecting the deterrent or protecting the population—there are again, in the judgment of many people, better ways to do either of those than ZEUS.

For protecting the deterrent in the short term you use hardening and in the long term you use mobility or you use air alert or you use the ground alert with effective warning, and so on.

VALUE OF FALLOUT SHELTERS AND NIKE-ZEUS COMPARED

For protecting population many people think that shelters are on a dollar basis much more effective than ZEUS, fallout shelters.

Mr. MAHON. Many people think that. What is your feeling for that?

Dr. YORK. That is what I think, myself. I think fallout shelters are a more effective way of saving lives in a ballistic missile attack than ZEUS.

Mr. MAHON. If your ZEUS missile is effective, will you still get quite a bit of the fallout problem?

Dr. YORK. If the ZEUS missile is truly effective and if the enemy shoots his missiles within range of the ZEUS, then you would not get appreciable fallout, but he has the alternative tactic, if he wants to produce fallout, of just shooting his missiles where ZEUS is not because ZEUS is a point defense system and not an area defense system in the sense that it does have a fairly wide range, but it is not something which prevents missiles from crossing the borders of the United States. It protects a roughly circular area centered around where the battery is.

POSSIBILITY OF DEVELOPING EFFECTIVE DEFENSE AGAINST THE ICBM

Mr. MAHON. Do you foresee that we will be able to provide an effective defense against the ICBM? I would like to elaborate a little before you proceed with your answer.

As you know, no one, insofar as we are aware, has been able to perfect a 100-percent defense against manned bombers. In World War II, I believe the average loss on bomber raids was about 3 percent, maybe slightly over 3 percent but not 4 percent. Of course, there were exceptions.

Can we look forward to an airtight defense against the intercontinental ballistic missile, which seems to be the great threat of the future?

Dr. YORK. I am not particularly optimistic. I might comment in the case of ZEUS that it is almost essential that it be 100 percent because it is soft and if it is not 100 percent, then the enemy, or if it is not close to 100 percent, then appropriate enemy tactics are to first attack ZEUS and get rid of it so that all the rest have a free ride. I am not particularly optimistic.

On the other hand, I, along with many others, believe that is it sufficiently important and so desirable to achieve missile defense that it is worth working on very hard. Therefore, we do have the ZEUS development program designed to check out and resolve some of these uncertainties. We have the DEFENDER program designed to search out other possible ways of achieving ballistic missile defense.

In other words, I am not very optimistic about it, but I thoroughly recognize its tremendous importance and, therefore, endorse working on it.

Mr. MAHON. In other words, you are to some extent saying that politically and psychologically you feel that we have to work on it.

Dr. YORK. No. I believe the problem is of sufficient importance that despite the fact that many of us are not optimistic, it is worth trying. Intrinsically, it is worth trying, not just politically and psychologically.

Mr. MAHON. There have been those who said that if you cannot knock down all approaching aircraft, looking back at the history of World War II with respect to those problems, how can you ever engage successfully the intercontinental ballistic missile which travels at such an unbelievable speed? There are those who come back with this observation: While the airplane may maneuver in most any way, the missile has a set course and cannot change its course; therefore, the ICBM is a sitting duck for defense in certain aspects of this problem. What is your observation?

Dr. YORK. These are compensating factors. An ICBM can do a certain amount of maneuvering, but so can the ZEUS. Probably the ZEUS can maneuver as well as the ICBM. That is, at the present time, or using present technology. These are compensating factors but it would be hard to say that one completely canceled out the other.

STATEMENT OF DR. YORK MADE AT COSMOS CLUB

Mr. MAHON. Mr. Secretary, I have a story which many of us read in the Washington Post some time ago, by John G. Norris, a very able reporter. Title of the story is "York Raises Questions on NIKE-ZEUS." Have you read that story?

Dr. YORK. Yes, I have.

Mr. MAHON. You were at the Cosmos Club, apparently. I quote from the story:

> Declaring that the present limit of approximately $40 billion on military spending imposed automatic limits on both research, development, and production programs, York said:
>
> "When we start something new and big, we automatically have to stop something that is big or cancel many smaller things."

WORKABILITY UNKNOWN

> Replying to a question in the audience, who noted he had failed to mention the ZEUS, York said that, "It is not known if it will work or not and what place it will have if it does." Army Chiefs have urged that the ZEUS be rushed into production as the only possible defense against the ICBM in the foreseeable future.
>
> The administration has held the missile defense program to a development product.
>
> York added that the ZEUS will be extremely expensive and that Pentagon officials must weight where to put our resources. He said that even if the defense budget were raised to $50 or $60 billion a year it would make serious inroads on other important defense programs.
>
> Discussing the ATLAS and TITAN ICBM programs, York said both should be continued.
>
> "Until 6 months ago we got a lot of advice about this," he said, adding that much of it came from Congress.
>
> "Why don't you 'fellas' wise up and cancel the ATLAS and concentrate on good programs like the TITAN and the MINUTEMAN," they said. York con-

tinued, "If we'd made a decision to cancel 8 months ago, it would have been to cancel the ATLAS, and this obviously would have been wrong."

TITAN HELD SUPERIOR

Now TITAN has a potential superiority over the ATLAS in "reliability, survivability, operationability and growth," York said.

He added that six or seven other deterrent weapons systems are coming along in the late 1960's and 1970's, including the B–70 bomber, the present nuclear bomber project, the nuclear ramjet, a "followon to the MINUTEMAN," the SKYBOLT air-launched ballistic missile and a longer range POLARIS. "We've got to continue work on all and make a decision later on which ones to produce," York said.

He said he and his aides also are faced with many more decisions as to which limited war weapons should be pushed.

Asked if he considered "armored surface ships obsolete," York said that emergencies like Lebanon have demonstrated the importance of "carriers, destroyers, and possibly cruisers" as "distant bases." He added that in a major war against a "highly sophisticated enemy like Russia, they are going to be blown up."

I like to see a man in your position have some character and individuality. I sometimes feel that people who are shot at from time to time in the press and by others get so gun-shy that they become afraid of their shadow and will not say anything that is worth while. They are so cautious that whatever they do have to say is rather meaningless and has very little meat in it. I am not complaining at this story. It seems very interesting and very provocative.

INCREASE OF FISCAL YEAR 1960 ATLAS PROGRAM BY CONGRESS IN SPITE OF FAILURES

I want to challenge this quote. I do not know whether you are quoted correctly or not, but you are quoted as saying that there was an attitude in Congress to cancel the ATLAS. I am astounded because I have heard lots of people say to cancel the TITAN and push the ATLAS, but I have not heard proposals to cancel ATLAS.

Dr. YORK. I said we were getting a lot of advice 6 months ago on this question from all sources, and I probably did say something about the Congress. I think that in the House Science and Astronautics Committee there were some discussions that I cannot quote chapter and verse, but I believe there were some discussions over there about this question. You will recall that last summer there was a time when there had been five successive failures of the ATLAS.

Mr. MAHON. That is right.

Dr. YORK. There was considerable suggestion that the ATLAS just did not have it and we ought to get on with something that would work.

Mr. MAHON. There may have been, all right, but certainly it was the only thing we had in the offing and we did not know whether TITAN would be better or worse.

Dr. YORK. That is right; we did not cancel it.

Mr. MAHON. I would like to point out, as you well know, this committee at that same time last year was advocating an increase of the ATLAS program. As you know, in our bill of last year, which passed early in June and was written up prior to that time, we included the starting funds for eight additional ATLAS squadrons. I am sure that in this statement you made you could not have possibly had in mind this subcommittee.

Dr. YORK. No, sir. Also, the context of this statement was in connection with certain suggestions these days that what we ought to do is cancel TITAN. I was pointing out it was not very long ago that we were receiving suggestions that we should cancel ATLAS and go ahead with TITAN.

Mr. MAHON. I remember that I did a little quaking in my own boots when I was advocating that we provide these eight additional squadrons for ATLAS at the time when we were having these failures but, nevertheless, we followed through and we have been rewarded in our putting our money, so to speak, on the ATLAS program.

Mr. THOMSON. Before the gentleman leaves that subject, might I ask a couple of questions?

Mr. MAHON. Yes.

Mr. THOMSON. No. 1: As appears in our hearings last year, which I presume you read, we seriously considered canceling the TITAN then. General Irvine testified somewhat at length about it. Do you recall that testimony?

Dr. YORK. I do, in a vague and general sort of way. The failures in ATLAS came subsequent to most of it. The long string of failures in ATLAS came subsequent to the hearings last year, I think.

Mr. THOMSON. The hearings the chairman mentioned were dated May 28, 1958; the bill came on the floor in June. At that time it was the recommendation of this committee to increase ATLAS, to the best of my recollection—you correct me if I am wrong—there was no discussion on the floor critical of the committee's report with reference to this program, and the bill passed almost unanimously.

Would you not take that to be the virtually unanimous direction of the House to go ahead with the program recommended by the committee?

Dr. YORK. Yes, sir.

Mr. THOMSON. Thank you, Mr. Chairman.

CLASSIFICATION OF SKYBOLT

Mr. FLOOD. I am curious about something else. At the hearings here, just within the last 2 or 3 weeks, I remember on the subject of the SKYBOLT they practically turned the lights out and stopped the clock when they talked to us about SKYBOLT. That was taboo above a whisper to mention the mere existence of such a concept. Even "Red" Raborn, who otherwise is a pretty solid fellow, not very cloak and dagger about this business, he was quite hush-hush about extending the range of POLARIS and did not want to go into that too much at all. Yet you, before the Cosmos people, dusted off and trotted out after dinner the whole story with no qualms whatsoever, particularly SKYBOLT.

Dr. YORK. I do not understand it because the Air people have talked about it in public for quite some long time.

Mr. FLOOD. It is very curious. The minute they approach this sacrosanct brown study here, they "dummy up".

Dr. YORK. General White talked about it before the National Press Club. At that time it was not called SKYBOLT, but he talked about the air-launched ballistic missiles.

Mr. HUFF. He called it SKYBOLT.

Dr. YORK. I have no explanation.
Mr. OSTERTAG. Mr. Chairman.
Mr. MAHON. Mr. Ostertag.

BUDGET CEILING

Mr. OSTERTAG. As I interpreted the quote that Mr. Mahon read with regard to this speech or interview, you made the statement which implied in substance that military spending limits were imposed by the administration on the overall military budget.

Dr. YORK. In my actual discussion I tried to say almost the opposite of that. I tried to say that we are working in a finite economy and that whether the spending is 40 or 41 or 42, 43 or 44 billion dollars, in this range, the character of the program would not be very different. If somehow or other the Defense budget was to turn out to be $50 or $60 billion, then the character of the program actually might be different.

What I was trying to get at and what I have also tried to get at on other occasions is that every once in a while you come across a case where somebody knows about a $50 million project and he says, "You are putting the budget ahead of survival by not asking for this $50 million." In most cases, projects of that sort, in essentially all cases, if you had another $50 million, that is not the way you would spend it anyhow. It is the fact that the budget is about $41 billion, plus or minus several billion dollars, that determines the character of the program and not that it is precisely $41 billion, whatever it is.

Mr. OSTERTAG. This article, as I interpreted it, implies that a rigid ceiling was placed on military spending, and that is not true; is that it?

Dr. YORK. I did not imply that or did not mean to imply it, and I do not hold that it is true.

Mr. OSTERTAG. The article implies it. I am not saying you did.

Dr. YORK. I suppose you could read it that way.

Mr. MAHON. I do not know of anybody who does not know that a ceiling of about $41 billion was placed on the Defense budget this year. I do not see how reasonable men could argue that.

Dr. YORK. About 41?

Mr. FLOOD. Is there any doubt about that?

Mr. OSTERTAG. There is in my mind, yes, for the reason that the Budget Director just recently made a very pointed statement that no absolute ceiling was placed on military spending. That is, an umbrella.

Mr. MAHON. The testimony of Mr. Stans before the full committee and the record of previous witnesses before this subcommittee, I think, cover that point well enough, and you have clarified your position with respect to the story. Let us go on.

With respect to budget ceilings, I would like to be brutally frank about a matter that troubles me. Are we postponing things, are we marking time, are we cooking up a real kettle of fish for the next administration, be it Democrat or Republican? In other words, we start a minimum program of the B–70, we have nothing but research and development in NIKE-ZEUS; we are holding the line on vast spending programs in some instances.

When the next President comes in and during the 4-year period in which he will serve, beginning in January 1961, is he not going to be confronted with a horribly difficult problem and are we not going to have to raise the Defense budget at that time? What does it look like to you?

Dr. YORK. That is a kind of tough one, Mr. Chairman, although my guess is that with the rising costs, both because of whatever inflation there may be and because of the increasing complexity and cost of weapon systems, I would expect the Defense budget to go up certainly as contrasted to going down.

Mr. MAHON. I sometimes wonder if this administration, in all sincerity—I am sure the administration is acting in all sincerity—is not, in order to keep from increasing the budget and in order to hold the budget and spending down, withholding decisions which later must be made and which will cause Defense spending to somewhat skyrocket. I do not see how we can continue this level of $41 billion if we are going to pursue these programs which are in the bill.

Dr. YORK. You are always going to pursue more development programs than you finally put into production. For example, in connection with the strategic deterrent, we are pursuing more different possibilities than I believe anybody will ever put into production. But the cost of pursuing them in the early development phase is only a few percent, maybe 5 percent, maybe 10 percent, of what the cost would be if you carried out a full-scale production program.

For this relatively small amount of money, you develop more information and more possibilities from which to choose at the time when you must make the choice of what the next generation of systems or weapons will be.

This leads to some hardship because it leads to inevitable cancellation of projects, and it is hard on the companies, but it is better for our defense posture.

Mr. MAHON. You do not think we are holding back a logjam which will tend to flood us some time during the 4-year period beginning in January 1961?

Dr. YORK. That will depend on the next administration's assessment of the threat and what we must do to meet it, and its decisions relative to whether we should go into large-scale production on one or many of those systems which are now in development or even in procurement but which they feel should be expanded.

Nothing we are doing is automatically producing that situation but, at the same time, it may be true.

Mr. MAHON. In other words, there is no designed effort to pass the buck to the next administration?

Dr. YORK. I do not believe so.

TECHNOLOGICAL EXPLOSION

Mr. SHEPPARD. Will the gentleman yield?

Mr. MAHON. Yes.

Mr. SHEPPARD. Dr. York, during the time you have functioned in your present position is this a fact or is it not a fact? Under the law of averages in research and development, a major portion of the definitive approach has been accomplished in the general field of scientific research? I do not mean it all has, but I mean it is pretty

well along, comparatively speaking, is it not? That is, from where we started to where we are now.

Dr. YORK. There has been a great deal done. We have a lot of information.

Mr. SHEPPARD. That is right, percentagewise. Under the research and development expenditures, using last year as an example, there is a greater opportunity for an escalated scientific development to go into operational category than has existed previously because of the background of experience in the field, comparatively speaking; is that right or is that wrong?

Dr. YORK. There is more information and, therefore, there are more possibilities.

Mr. SHEPPARD. That is correct; so that, irrespective of what may be done now, there is every prospect in the scientific field, as it may be evaluated by gentlemen far more pronounced in that field than myself, to have an opportunity to bring into production a greater number of items for evaluation and production purposes than has prevailed heretofore.

Dr. YORK. Yes; I guess this is the statement that there is what amounts to a technological explosion going on at the present time.

Mr. SHEPPARD. Yes. The results of the explosion will be more prominent in the next year than at the present time, comparatively speaking.

Dr. YORK. Yes; that is why I said yesterday we do not have the opportunity to choose between good and bad programs; we are only choosing between superior and excellent programs.

IMPROVEMENTS IN ROCKET ENGINES

Mr. SHEPPARD. I notice, reflected on page 6 of your statement, the following language:

> **While we are admittedly behind the Russians in the development of very large thrust boosters, the use of IRBM's and ICBM's as first stage boosters for our near earth satellites provides us with a payload capability adequate for our immediate military needs.**

Our problem in the general field of research, so far as the thrust power is concerned, conceding at the moment we have enough thrust power to meet our requirements, nevertheless, there is a very definite, I understand, program in here to get greater thrust power on a diminishing weight factor premise. Particularly does that apply in the solid propellent field. Am I right or am I wrong?

Dr. YORK. Yes, you are right. We are continuing to seek better rockets. "Better" covers a great many possibilities.

Mr. SHEPPARD. It does, but, Doctor, while it covers a multitude, nevertheless, the basis is premised upon the payload factor involved and the thrust power factor; is that right?

Dr. YORK. We are trying to get more payload for less rocket.

Mr. SHEPPARD. For less weight; is that correct?

Dr. YORK. Yes.

Mr. SHEPPARD. And we are actually exercising a tremendous effort in that field, are we not?

Dr. YORK. Yes. In fact, it is expanding. As ICBM's and IRBM's phase out of development, that is an expanding field.

Mr. SHEPPARD. Would you consider, in the field of your knowledge, that that particular factor is of extreme importance to accomplish?

Dr. YORK. Yes; we are just in the beginnings of the uses of rockets for military and other purposes. It is extremely important to push forward with technological improvements of all sorts, including, and perhaps including specially, getting bigger payloads for smaller rockets.

Mr. SHEPPARD. That is all.

Mr. MAHON. Mr. Minshall?

Mr. MINSHALL. I pass for the moment.

FUTURE OF ARPA

Mr. MAHON. The budget estimate for fiscal year 1961 for the Advanced Research Projects Agency is $215 million. The fiscal year 1960 appropriation for ARPA was $455 million. During calendar year 1959 several important military space technology projects were transferred from ARPA to the Air Force and NASA. Do these reductions in funds and projects indicate that ARPA is to be discontinued?

Dr. YORK. No. They show the changing character of ARPA from an agency which, in terms of budget, was heavily engaged in hardware projects in the space area to a situation where it will be engaged essentially, only, in advanced research of long-range military interests.

Mr. MAHON. Do you believe the establishment of your office with its control of the research programs of the military services eliminates the need for ARPA?

Dr. YORK. No; it eliminates the need for ARPA as an independent agency and that has been accomplished.

The Reorganization Act of 1958 gives the Director of Defense Research and Engineering, or gives the Secretary, authority to pass on to the Director of Defense Research and Engineering, control, or delegates to him the authority to supervise certain programs on a a centralized basis.

ARPA is my mechanism for doing that.

Mr. MAHON. Should your office allocate the programs under ARPA to the military services?

Dr. YORK. Should it what?

Mr. MAHON. Should your office just allocate these programs which ARPA is working with to the military services?

Dr. YORK. ARPA is in my office and does, in terms of dollars, 99-plus percent of its business through the services.

FUNDS FOR BASIC RESEARCH

Mr. MAHON. Yesterday we made some reference to basic research.

How much money is requested for basic research? Will you give us a service-by-service breakdown of basic research funds?

Dr. YORK. Yes, sir.

Mr. MAHON. You can supply that for the record.

Dr. YORK. Yes, sir.

(The information follows:)

Department of Defense—Basic research

[Millions of dollars]

Department	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961
Army	26.0	26.8	27.4
Navy	44.8	58.1	58.6
Air Force	42.6	37.9	42.1
ARPA	5.5	[1] 8.0	[1] 8.0
Total	118.9	130.8	136.1

[1] In addition ARPA has a $17,000,000 materials research program with universities which has just been initiated in fiscal year 1960.

COORDINATION OF BASIC RESEARCH PROGRAMS OF SERVICES

Mr. MAHON. Does your Office attempt to coordinate the basic research programs of the Services?

Dr. YORK. Yes, sir.

Mr. MAHON. Most research projects are funded at less than $2 million annually, and thus do not require specific approval from your Office, so I understand.

Dr. YORK. They do not require prior approval during the course of the year.

At the time the budget is prepared, my Office of Science does review the programs of the three departments and ARPA.

Mr. MAHON. Please make that clear for the record.

Dr. YORK. This $2 million is a requirement for prior approval before making a change. It does not apply to the initial proposals which support the budget estimates.

Mr. MAHON. Since we have an Advanced Research Project Agency, would it be wise to place all basic research under this Agency and have one basic research program instead of four in the Department of Defense?

Dr. YORK. I think not.

Mr. MAHON. A staff report, to which I will refer in more detail later, states that ARPA plays a part in determining roles and missions in the services by assigning its research projects to the services without regard to roles and missions.

Since the mission will follow capability, ARPA is in fact assigning roles and missions, or so it would appear.

Do you think this is a good practice?

Dr. YORK. I do not really think that is an important factor—ARPA certainly does not assign roles and missions.

(Further information on this matter may be found in the appendix on p. 511.)

MEDICAL RESEARCH

Mr. MAHON. What is the total cost of all medical research being requested by the Department of Defense?

Can you give us a service-by-service breakdown of these costs for the record?

Dr. YORK. I cannot at this point but I can provide it for the record. It is not very large.

(The following tabulation was submitted:)

Department of Defense—medical research

[Thousands of dollars]

Department	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961
Army	14,629	18,600	21,200
Navy	5,256	5,900	4,600
Air Force	4,357	4,800	3,900
Total	24,242	29,300	29,700

Mr. MAHON. In view of the many urgent programs of weapons development required, do you think some of this medical research could be left up to the Department of Health, Education, and Welfare and the many non-Government medical research facilities?

Dr. YORK. No, I think not because nearly all of the medical research we do is pointed toward the uniquely military problems.

Mr. MAHON. To what extent do you screen your medical research programs to determine their essentiality as military requirements?

Dr. YORK. We screen them to the best of our ability. This is done in a cooperative fashion and actually, in this case, it is my Office of Science and the Assistant Secretary of Defense for Health and Medicine.

Mr. MAHON. NASA is reported to have created a new Office of Life Sciences which will cover the fields of biology, medicine, and psychology. Will this office probably duplicate military efforts in space medicine?

Dr. YORK. It could, if we were not careful about it. We are in the process of setting up a joint board between Defense and NASA for the purpose of reviewing all of the programs in the field. The Defense member, or one of the Defense members, is the same man who is responsible for reviewing these things for me within Defense.

INVESTIGATIVE STAFF REPORT ON MISSILE PROGRAMS

Mr. MAHON. I would like to take up with you in behalf of the committee a study by our investigative staff the military missile programs.

Most of the report is devoted to factual information on missiles which is classified. There is a section, however, which is devoted to a problem with which the committee has been concerned for a number of years. This is the problem of administrative review of various missile projects of the respective military services.

This section begins on page 23 of the report and ends on page 42. With the concurrence of the committee, this section will be inserted in the record at this point.

The members can check that and later we can determine if there is any objection. The members of the staff feel it is all right and I agree with their views.

Mr. OSTERTAG. Has the Department had a chance to see this, Mr. Chairman?

Mr. MAHON. No.

Mr. OSTERTAG. Our understanding was to the effect that we would make it available to them for response.

Mr. MAHON. This is more or less a factual statement and it is not a critical statement. We will check that later and see if there is any impropriety invoved.

(The portion of the report referred to follows:)

ACTIVITIES OF THE OFFICE OF THE SECRETARY OF DEFENSE, INCLUDING THE JOINT CHIEFS OF STAFF IN GUIDED MISSILE DEVELOPMENT PROGRAMS

A. DUPLICATION IN THE REVIEW PROCESS

Since the last staff report, considerable change has been made in the organization of the DOD, especially in the field of research and development. This has been based primarily on the DOD Reorganization Act of 1958, but prior to that correction had been made of the duplication in reviews to which attention was called in the staff survey of January 1957. This duplication arose from confusion as to the dividing line between the jurisdictions of the Assistant Secretary of Defense (Research and Development) and the Assistant for Applications Engineering. These positions were combined by Department directive 5129.1, dated March 18, 1957, into the single position of an Assistant for Research and Engineering.

To more definitely establish jurisdiction over research and development, the above-referred-to Reorganization Act created a Director of Defense Research and Engineering. The act provides in part that:

"The Director performs such duties with respect to research and engineering as the Secretary of Defense may prescribe including, but not limited to, the following: (1) to be the principal adviser to the Secretary of Defense on scientific and technical matters; (ii) to supervise all research and engineering activities in the Department of Defense; and (iii) to direct and control (including their assignment or reassignment) research and engineering activities that the Secretary of Defense deems to require centralized management."

Pursuant to the above act, a new Department directive 5129.1, dated February 10, 1959, was issued, canceling the previous one of March 18, 1957, thereby eliminating the Assistant Secretary (Research and Engineering) and giving the new Director broad powers in the fields of scientific and technical matters, including basic and applied research; development, test, and evaluation of weapons systems and "design and engineering for suitability, producibility, reliability, maintainability, and materials conservation."

While the Assistant Secretaries of Defense (Comptroller), (Properties and Installations), and (Supply and Logistics) are concerned with the sufficiency of available funds, sites, and general logistic support, respectively, for both developmental and operational missiles, it is the Director's responsibiiity under the above directive "to coordinate actions as appropriate, with the military departments and other Department of Defense agencies having collateral or related functions in the field of his assigned responsibility." He is also authorized to "approve, modify or disapprove programs and projects of the military departments and other Department of Defense agencies in his assigned fields to eliminate unpromising or unnecessarily duplicative programs, and initiate or support promising ones for research and development." The above powers should be sufficient for the Director to avoid not only duplication in the missile programs themselves, but also such duplicative situations as previously existed in the reviewing of these development programs within the OSD.

The Director's Office is new and in its first year of operation only one conflict is known to have arisen as to its jurisdiction and this was quickly resolved. The Advanced Research Projects Agency (ARPA) was created by Department directive 5105.15, dated February 7, 1958, 3 days prior to the directive establishing the jurisdiction of the D.D.R. & E. ARPA was given broad powers for "the direction or performance of such advanced projects in the field of research and development as the Secretary of Defense shall, from time to time, designate by individual project or by category." One of the projects subsequently so designated involve basic research in connection with defense against ballistic missiles. No reference was made to any supervision over this agency by the D.D.R. & E. This resulted in confusion and differences of opinion between the Directors of these two agencies as to whether ARPA was subject to D.D.R. & E. supervision.

The Secretary of Defense in a statement before the House Committee on Science and Astronautics on March 2, 1959, less than a month after the creation of both offices, cleared up the situation. He stated:

"There are four basic operating research and engineering agencies in the Department of Defense: Army, Navy, Air Force, and the Advanced Research Projects Agency. These agencies do research and engineering of a varied nature consistent with their assigned duties. The research they undertake may be done within their own facilities or by contract with outside sources, depending on which in their judgment will produce the best results. The function of the Director of Defense Research and Engineering is to supervise and coordinate all research and engineering, regardless of what element of the Department of Defense does the work or the nature of the work undertaken."

To formalize this statement, he issued a new Department directive 5105.15 on March 17, 1959, making clear the responsibility of D.D.R. & E. for supervision and coordination of the work of ARPA as an operating agency.

The Secretary of Defense by the same statement to the above House Committee on March 2, 1959, eliminated another possible source for conflicts in jurisdiction. On November 15, 1957, by Department directive 5105.10, a Director of Guided Missiles had been created with authority to "direct all activities in the Department of Defense relating to research, development, engineering, production, and procurement of guided missiles." Mr. William M. Holaday was appointed to this position. In his statement to the committee, the Secretary of Defense announced as follows:

"The research and engineering duties of the Director of Guided Missiles together with personnel involved will in the near future be transferred to the Director of Defense Research and Engineering. This transfer will be made in a way which will insure no loss of the momentum our missile program has developed. Mr. Holaday will, for an indeterminate period, remain as a special assistant to me to continue to handle those aspects of the guided missile programs *which are beyond the research and engineering and testing phase* in addition to his duties as chairman of the Civilian Military Liaison Committee provided for in the act establishing the National Aeronautics and Space Agency." [Italic supplied.]

The directive referred to above creating the Director of Guided Missiles was canceled April 8, 1959, Mr. Holaday having been made Special Assistant to the Secretary of Defense for Guided Missiles on that date with the duties outlined in the Secretary's statement.

One other question of jurisdiction remains. When the ballistic missiles program was expedited in 1955, another organization was set up, the Ballistic Missiles Committee of OSD, and it was decreed by the Secretary's series of memorandums of November 8, 1955, directed to the services, to be "the single agency within DOD for all matters requiring OSD attention and for approving ICBM–IRBM development programs * * * ." This committee is still in existence and it would appear that its authority overlaps that of D.D.R. & E. based upon the above wording. This committee was created pursuant to a recommendation in an Air Force study for simplifying administrative procedures for the ICBM and IRBM programs. The wording of the Air Force recommendation does not serve to clear up this question as it refers to the committee as the "single point of contact to which the Secretary of the Air Force will report and as a single program review and approval authority at the OSD level." Nor does the directive referred to above creating the D.D.R. & E. mention the Ballistic Missiles Committee or any dividing line between its jurisdiction and that of the D.D.R. & E.

This lack of definition as to the jurisdictional boundary between these two agencies as a practical matter does not appear to have caused duplication or conflict between them. The D.D.R. & E. is a member of the Committee which is under the chairmanship of the Deputy Secretary of Defense. On the Committee also are the Assistant Secretaries of Defense (Comptroller), (Properties and Installations) and (Supply and Logistics) in view of their interests in the missile systems as pointed out above. The Bureau of the Budget, upon invitation, has also assigned a representative to this Committee. Although the Secretary's memorandum setting up the Committee does not make this differentiation, the Committee has been described as being in practice a device for getting simultaneous decisions where necessary from each of the agencies represented concerning their specific field of responsibility based upon a joint presentation or briefing rather than a body which makes a joint decision by vote of the

majority. In other words, the D.D.R. & E. makes the decisions at the meetings of this Committee dealing with the approval, modification, or disapproval of "programs and projects of the military departments and other Department of Defense agencies in his assigned fields to eliminate unpromising or unnecessarily duplicated programs, and initiate or support promising ones for research and development." This description of how the Committee operates conforms to the purpose for which the Air Force recommended that it be formed; i.e., to eliminate the requirement existing at that time that various aspects of these urgent programs be routed through the offices of at least five Assistant Secretaries of Defense for clearances. The Committee has been credited with eliminating this circuitous method of obtaining decisions and with shortening the decision-making process appreciably by bringing together at one time in plenary session those who must give concurrences.

So long as the above is true, the D.D.R. & E. is the sole official under the Secretary of Defense having authority over the type of reviews, referred to in the Committee directive, in connection with missiles under development.

As to duplication between the reviews in OSD and those in the services, the last staff report pointed out that the reviews made at these two levels are for different purposes. OSD is not an operating agency, but is an administrative agency to assist the Secretary of Defense in exercising direction, authority and control over DOD. Reviews of the work of the operating agencies are essential in order for the Secretary to exercise his authority by approval or disapproval of recommendations and to make the other necessary decisions in fulfilling his responsibility. It is, likewise, necessary for reviews to be made at the service level in carrying out the operating responsibilities there. It cannot be said therefore, that the mere fact that reviews are carried out at both levels indicates wasteful duplication. The question is rather one of whether the reviews undertaken at the OSD level are effective and, if not, they are, of course, wasteful. A discussion of these reviews in this regard will be found further on in this section.

B. DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

1. Duties of the office

As pointed out above in the discussion of duplication, the Director of this agency, according to the Reorganization Act of 1958, is authorized to perform such duties with respect to research and engineering as the Secretary of Defense may prescribe. The Department directive 5129.1, dated February 10, 1959, as quoted above, prescribed that this Director should approve, modify or disapprove any item in research, development, test and evaluation appearing in the programs and budget requests of the services. He also has the responsibility to initiate programs to fill gaps in the weapons available disclosed by his reviews. Under this authority, he conducts the type of review of missiles during their development referred to in the committee directive as being with reference to:

"a. The relative value of each missile as a weapon."

The Reorganization Act specifies as one of the duties which might be delegated to the Director "the direction and control (*including their assignment or reassignment*) research and engineering activities that the Secretary of Defense deems to require centralized management." [Italic supplied.] The Secretary of Defense in his directive referred to above has delegated to the Director the authority to disapprove a program "to eliminate * * * unnecessarily duplicative programs," but has not authorized the reassignment of programs by the Director. The directive on this point provides that the Director can only "recommend the assignment or reassignment of research and engineering responsibility for the development of new weapons or weapon systems, giving due consideration to the departmental functions set forth in DOD directive 5100.1." The latter directive dated December 31, 1958, sets forth the roles and missions of the services. Under these provisions the D.D.R. & E. in reviewing missiles while under development does take cognizance of the second point referred to in the committee directive as:

"b. The relationship of the proposed and probable use of each missile to the assigned roles and missions of the military service developing the missile."

He has the responsibility to disapprove the program if the roles and missions as defined in the last-mentioned directive indicate unnecessary duplication will occur. He also has the responsibility to recommend reassignment of the program to the proper service if he believes this should be done.

In addition to the above duties, the Director consults with the JCS on interaction of research and development and strategy; coordinates actions, as appropriate, with other agencies of the DOD; and maintains liaison with appropriate research and development agencies outside of the DOD. He also exercises administrative direction over the WSEG and assures that this group is responsive to the needs of the JCS and the OSD for operations analysis.

2. Organization of the Office

The Office of D.D.R. & E. consists of approximately 200 people and, in addition to normal staff functions, is set up (*a*) functionally to cover technical areas of work such as guided missiles, aeronautics, electronics, science, etc., and (*b*) to review operational systems such as air defense, tactical weapons, strategic weapons, etc.

The office, due to its having been in existence only a short while, has been described as being in a state of transition with the duties of the various officers being gradually fixed by the decisions being made as new problems come up concerning the separation of duties between those offices. The offices covering the technical fields were part of the old organization but the positions of the assistant directors assigned to specific operational systems were established with the creation of the new office of the D.D.R. & E. These new offices are interested primarily in whether the technical developments underway will fit into specific missions.

For instance, if a certain program should involve guided missiles then the Director for Guided Missiles who is in charge of the technical office dealing with these missiles would have an interest in the technical developments. If the program should be part of the air defense or of the tactical or strategic systems, it would also be considered by the Assistant Director covering those particular fields. No written directives outline the division of authority between the technical offices and the operational systems offices. Representatives of these offices state that there is no confusion because of this lack of definition since each office staff is small and when both offices are interested in the same program, they consider the matter jointly and contribute to the decision reached.

3. Method of reviewing programs

Just as the duties of the various offices within D.D.R. & E. are not well fixed as yet, so also the methods of operation have not as yet settled down to the point where they are uniform and can be defined. Nor have any written regulations been issued intraoffice or to the services giving instructions as to the procedure according to which reviews are to be made. Certain principles, however, are said to have been established. Any reprograming, which includes the initiation of a new project, involving $2 million or more in the current year, must be specifically studied and approved by the appropriate office. Review is also required of any program regardless of the initial amount which will involve $10 million or more in the succeeding 3 years. This regulation contains a weakness in that a service can avoid OSD control of a program by coming to a conclusion that only $9 million will be spent on it in the next 3 years. The $2 million limit will probably be fixed as the dividing line as items of this amount and over involve over 50 percent of the money in the research and development budget. By attempting to specifically approve programs under this amount, it was said that only a small additional amount of money would be so approved and it would require a very much larger staff. As this arrangement is just going into effect, the success of it has not as yet been established. For research and development programs under the above amounts, no specific approval is required but the program must be reported and is assumed to be approved if no objections are raised to it.

Twice a year, the D.D.R. & E. has an opportunity to review all programs on a line-item basis by virtue of the budgetary process. In fact, the first information concerning all new programs will probably come out in the information furnished in justification of the line items in the budget. The apportionment under the budget which occurs quarterly from a fiscal standpoint will afford an opportunity on a semiannual basis for reviewing the progress of the work so that a determination can be made as to the advisability for the continuance thereof. In these reviews, provision can be made for the release of funds in a certain program with deferrals connected with it so that the funds will not be available until certain conditions precedent have been met. It was stated that under this provision some of the 1960 funds are still tied up by deferrals until certain technical considerations have been resolved.

It was pointed out that there is some danger of irresponsible action in connection with these deferrals in that it makes it possible for the supervising official to defer a program merely because has has not himself met the necessary deadline in obtaining the facts necessary for him to form his opinion. Under these circumstances, a deferral merely to give him additional time to form an opinion may contribute nothing to the program other than a delay. To avoid this, the office has been stressing the fact that the supervising officials must get out into technical areas and become familiar with their programs so that they may be able to foresee changes that may arise and be prepared to approve, disapprove, or modify them without delay.

The mechanics by which reviews are instituted and carried out, likewise, have not been defined in writing but are based on understandings which have developed. Study programs can exist without specific money being designated for them, but prior to the award of a research and development contract, the money must be available and the approval of D.D.R. & E. is required before it can be made available. In order to save time, a working relationship is said to have been established between D.D.R. & E. and the services so that the former will be made fully cognizant of the program to be suggested in the budget a sufficiently long time before the budget is presented to give D.D.R. & E. ample opportunity to make a complete study and give a prompt decision on the budget. The study made by D.D.R. & E. is based on briefings from the interested services and manufacturers and on occasional trips to manufacturing facilities. When a decision is reached to approve a program a memorandum is sent to the Office of the Assistant Secretary of Defense (Comptroller) to release the funds.

Various factors were named by officials of D.D.R. & E. as being considered in reviewing the programs presented by the services. As to new programs, determinations are made concerning the following points:

(*a*) The need for such an item and whether particular program meets the need and is technically feasible;

(*b*) A comparison of the program with all other missiles for duplication;

(*c*) How the employment of the particular missile will conform to the overall defensive or offensive plan; and

(*d*) The reasonableness of its cost when considered in connection with its expected performance.

As to advanced missiles, referred to as follow-ons to older systems, the questions must be answered as to whether the new system will provide only marginal improvement over the old or whether it will be a sufficient step forward so that it will provide the necessary advanced capability at the future date on which its operational availability is expected to occur.

As to review of continuing programs, determination must be made of the following:

(*a*) The adequacy of the management;

(*b*) The existence of any gaps which may have developed in the program which will require research before completion can be expected;

(*c*) The progress which has been made and whether it conforms with the schedule presented by the service when the program was initiated. Programs found to be behind schedule are scrutinized closely for the problems and the steps being taken to correct them; and

(*d*) The existence of new, more advanced programs or developments which may make the program under consideration obsolete now or before it becomes operational or so soon afterward that continuing with the development would not be worthwhile.

4. Scientific and technical assistance

All of the staff of the Office of the D.D.R. & E. with the exception of the Director of the Office of Review and Services, which concerns itself with the internal administration of the organization, possess scientific educational backgrounds to qualify them for their work, but they are necessarily limited to a large extent to relying on information furnished to them rather than on research or investigation conducted by themselves in arriving at a determination of all the questions listed in the last several paragraphs.

In the last staff report, the following was stated:

"The staff review indicates that probably the greatest single weakness in the missile program is the failure of OSD to have an effective organization for the evaluation of missiles. The inadequacy of past studies has been recognized within the OSD for some time. Our review disclosed that in the main evalua-

tions have consisted of 'briefings' or 'presentations' made by admittedly biased groups. Decisions to continue programs have been made following consideration of the data relating to a particular missile as produced principally by contractors' representatives of the sponsoring services * * *.

"The staff had hoped * * * that the Weapons Systems Evaluation Group (WSEG) may have evaluated some guided missile weapons system. Our inquiry indicates this group has been singularly inactive in this area. In a tabulation entitled 'DOD Evaluations of the Current and Prospective Capability of the GM Weapons System,' dated October 22, 1956, WSEG figured in only 1 of some 30 listed—and this one had only recently begun. There were indications, however, that this one (which has now been completed) represented both a new departure for the WSEG and a worthwhile step in the new direction * * *. It is through failure of this evaluation process that duplicating programs arise or obsolete programs are permitted to continue * * *."

(*a*) *Weapons System Evaluation Group (WSEG).*—This group functions under the administrative direction of the D. D. R. & E. and is responsive to directives from that office and from the JCS. The director of the group is appointed by the Secretary of Defense, with the advice of the JCS and the D. D. R. & E. from among the senior officers of the DOD. The mission of WSEG is: (1) To provide the DOD with comprehensive, objective, and independent analyses and evaluations under projected conditions of war, which will include but will not necessarily be confined to: (*a*) present and future weapons systems; (*b*) the influence of present and future weaposn systems upon strategy, organization, and tactics; (*c*) the comparative effectiveness and costs of weapons systems; and (2) to make available to the DOD timely advice and assistance to aid decisions in the allocation of resources for development of the most effective combination of weapons systems. These functions are specified in Department Directive 5128.8, dated April 13, 1956.

In carrying out the above functions this group conducts approximately 10 or more operational research studies at a time and receives these task orders from the Director of Defense Research and Engineering or from the Joint Chiefs of Staff. Regardless of which might make the assignment, the studies are of equal interest to both and both get copies of all reports. It was estimated that about 80 percent of the tasks assigned to this group come from the Joint Chiefs of Staff. To illustrate the nature of the studies made by this group, at the present time they are looking into the effectiveness of electronic countermeasures on the operating forces. This study will extend for a 3-year period and will involve an extensive amount of flight time and time taken up with sea voyages with numerous mock attacks being staged both using and not using electronic countermeasures. This study is an extremely important one since electronic countermeasures is said to be a big unknown factor in the evaluation of a number of missile systems. It is also significant in that this is the first time that Weapons Systems Evaluation Group has actively gone into the field and conducted an experiment into the way a thing should be done.

The group's present capability has been built up from an unfavorable beginning. At one time, it was criticized for the length of time taken to submit its reports. Finally, 3 years ago, an outside contract was let to the Institute for Defense Analysis to furnish the professional personnel necessary for its operation. It is under the supervision of a military director, and under him there are 35 military and 42 civilian employees. The professionals furnished under the contract number approximately 100. Under the reorganization, the capability of this organization, according to the Director of Defense Research and Engineering, has risen steadily. The reports are said to be better, more usable, and more current.

The staff was not able to evaluate the reports of this group because the Director of Defense Research and Engineering refused to make these reports available to the staff for examination. It has been determined, however, that since the last staff survey in 1957, 10 studies have been made by this organization. Four were requested by D. D. R. & E. Two of these studies involved the NIKE–ZEUS, one in 1957 and the other in September 1959. A study of the SAGE was made in 1957, and a study, in which the use of missiles in limited warfare was considered, resulted in reports in 1958 and 1959. Both were made at the request of D. D. R. & E.

The balance of the studies made on request of JCS concerned a number of subjects. The relative value of missiles and aircraft was the subject of reports in 1957, 1958, and 1959. A study of locations for ICBM launching pads was made in

1957. An overall examination of offensive and defensive weapon systems including missiles was made in 1958 and specific studies as to sea-launched (POLARIS) and air-launched (ALBM) missiles for surface attack were made in 1959. In addition, the study of electronic countermeasures referred to above was also a JCS task assignment.

The studies made by WSEG for D. D. R. & E. received servicewide dissemination. The responsibility is assigned to the appropriate organization to follow up the conclusions and recommendations of the report. Results of studies made by WSEG for JCS are made available to D. D. R. & E.

(*b*) *Scientific Advisory Committee.*—This Committee is composed of outstanding civilian scientists and experts who provide technical services and advice regarding ballistic missile matters. Dr. Clark B. Millikan is Chairman. There are 15 other full-time members and 4 who are called upon for assistance on a part-time basis. Eleven are from institutions of higher learning, 5 hold Government positions, and 3 are from business.

This Committee originated with the ballistic missile and its activities are confined to that field. It is not to be confused with the Science Advisory Committee in the Executive Office of the President. It was established in 1953, under the leadership of Dr. John von Neumann as the Strategic Missiles Evaluation Committee, to advise the Air Force as to the feasibility of the ICBM and subsequently was transferred to OSD.

Its reports were not made available to the staff for review but advice was received that in its field of ballistic missiles, it has continuously reviewed the programs, including space projects, which might be applicable to the defense of the country. Reviews have been made of the ATLAS–TITAN developments, the MINUTEMAN, the PERSHING and ALBM programs, and certain aspects of the basing of the ATLAS.

The reviews of this group are made by them personally at 4 or 5 meetings a year each of which lasts 1 or 2 days. When they decide upon a subject for review, the interested services and manufacturers appear before them and through the close and searching questioning made possible by their backgrounds, they are said to be able to develop the necessary basis for their recommendations. The Office of the D. D. R. & E. stated that the recommendations of this group "have been generally followed."

(*c*) *Advisory Panel on Aeronautics.*—This Panel was created by Department directives 5129.14, dated August 14, 1957, to provide technical advice to the DOD on all research, development, and engineering in fields of piloted aircraft, manned and unmanned lighter-than-air aircraft and guided missile weapon systems.

Like the Scientific Advisory Committee, the steering group of this Panel is made up of a representative group of scientists. The Chairman is Mr. William C. Littlewood, vice president, American Airlines, Inc. Five members have Government positions, 5 are officials of large corporations in aeronautical fields, and 3 are from institutions of higher learning.

The operations of this group are unlike those of the Scientific Advisory Committee. The steering group makes no studies as such. It is engaged in management of the Panel and establishing its policy. It meets each month at which time it is briefed by the staff of D. D. R. & E. on existing problems in an informal way. It then decides whether certain members of its Panel, made up of technical employees of companies performing contracts in the field of aeronautics and employees of research centers at various universities, can be of help with these problems. If so, an ad hoc committee of 5 or 6 from the Panel work on the problem, sometimes continuously for a period of 2 or more weeks or sometimes for a period of 2 days per month for a year or more.

In the field of guided missiles, this group considers problems of all missiles except the ballistics which are handled exclusively by the Scientific Advisory Committee. Its reports were not made available to the staff but advice was received that studies have been made by the group concerning problems involved in the SLAM, EAGLE, and BOMARC programs. At the present time, a group of propulsion experts are examining the probabilities for advanced propulsion during the next 10 years covering liquids, solids, and storable liquids.

The advantages of having these studies made are several. The people called upon know operating problems and yet from the Panel it is possible to select those to conduct the studies whose companies are not involved in the subject matter. The men are able to give a fresh outlook to the problem which is not available to those whose interests are involved in the matter. By planning studies as to the feasibility of extending the state of the art in various areas, the D.D.R. & E. is able to keep ahead of new developments being suggested by the services and can give these suggestions better appraisals.

5. Evaluation of the reviews

The following conclusions have been reached concerning the reviews made by D.D.R. & E.:

(*a*) In dealing with programs of such importance both from national security and financial standpoints as the guided missiles programs, the D.D.R. & E. should as soon as possible clearly define by written directive the various duties of his assistants and the procedures to be followed in order to guarantee uniform, thorough and timely reviews of the programs in the field of his assigned responsiiblity. These procedures should be fixed not only for his own office but also for the gu dance of the services in seeking approval of their programs.

(*b*) Limiting reviews to programs which involve over a given dollar amount per year is probably a practical way of confining the work to the more important subject matter, but it leaves gaps in the review system which should be filled. This is recognized by D.D.R. & E. in establishing an additional criterion as to programs to be reviewed to include those which will involve $10 million or more in the succeeeding 3 years. As pointed out above this registration is weak.

It is believed that the determination of what missile programs are to be reviewed should be governed by the subject mater embraced in the program rather than the amount of money involved on a yearly basis. There will be few, if any, guided missile research and development programs that will not involve eventually more than $10 million each. So it seems that each of them could be safely reviewed as a prerequisite to the execution of the research and development contract.

This appears to be the most effective time for a review as it is a crucial point in the program. If a research and development contract should be let with unsolved problems still existing which should have been resolved in the feasibility study, then a number of people have acquired an interest in the situation and termination of the contract becomes difficult, if not impossible, when it becomes apparent that these unsolved problems make the continuance of the program inadvisable.

It is believed that it is at this point that a review should be made to determine whether the program comes within the roles and missions of the service proposing it, whether problems of feasibility and details of costs have been fully worked out and all of the other factors to be considered in reviewing new programs as listed above have received full attention. The opinion has been expressed by several scientists that a thorough review at this critical point should make it possible to reduce the number of subsequent reviews.

C. JOINT CHIEFS OF STAFF

The JCS are the principal military advisers to the President, the National Security Council, and the Secretary of Defense. They constitute the immediate military staff to the Secretary of Defense, serving in the chain of command that extends from the President to the Secretary of Defense, through the JCS, to the commands of unified and specified commands. Each member of the JCS, other than the chairman, is responsible for keeping the Secretary of his military department fully informed on matters considered or acted upon by the JCS.

The JCS as advisers in operational direction of the Armed Forces have numerous responsibilities in the areas of strategy and logistics. Of particular interest to this staff was the prescribed function of reporting programs of sicentific research and development to the Secretary of Defense. Advice was received from representatives of OSD and personnel within JCS that interviews with JCS personnel would not be permitted. Consequently, the staff was unable to determine the types of reviews given missile programs by JCS.

NEED FOR WRITTEN DIRECTIVES CONCERNING REVIEW PROCEDURES

Mr. MAHON. The staff report has been made available to the members of the committee and I would like to discuss some of its pertinent points with you now.

The staff report states that the methods of operation of your various offices have not yet settled down to the point where they are uniform and can be defined. It is further stated that no regulations

have been issued intraoffice or to the services giving instructions as to the procedure according to which reviews are to be made.

The staff then recommends that you should, as soon as possible, clearly define, by written directive, the review procedures to be followed, not only for the guidance of your Office but for the guidance of the services in seeking approval of their programs.

Is there any validity to this comment? I wish you would comment on this.

Dr. YORK. I do not have the formal directives on how people should proceed, but I could get them out.

The situation is sufficiently fluid with regard to personnel, both in my Office and in the services and with regard to learning how to do this, what is the right way to treat these, that I have not felt it was the best thing to do to issue such rules.

Actually, for example, requests for emergency funds come into our Office of Review and they are channeled to the appropriate technical or systems office in my organization. The Office of Review does know where these things are supposed to go and Mr. Huff, who is the Director of that Office, says we have an instruction out on that.

This is the way we are doing it; this is what I regard as being the best compromise between what you would do in an ideal situation and in a permanent organization where everyone involved, both in the Office and outside, has worked together and was going to continue to work together for years and years, and the situation that we have, where so many of the key people, both in the service and our own Office, are new.

For example, when I get a new man in one office, there might be reasons for having someone else who has been around longer, but is in a related office, to handle these instead of just following the proforma rules of, "We have been doing it this way, and let us continue it this way."

There is more flexibility the way it is now.

Mr. MAHON. You think the present system is as good as you can do under the circumstances?

Dr. YORK. Well, I suppose you can always do better. It is as good as any I know how to do right now.

Mr. MAHON. The report to which I have referred also states that you have, in your organization, offices set up functionally to cover technical areas of work, such as guided missiles, electronics, and so forth, and other offices to review operational systems, such as air defense, tactical weapons, strategic weapons, and so forth. No written directive outlines the division of authority between the technical offices and the operational systems offices.

It is stated that since the offices are small, no confusion has been reported, but the staff seems to feel that the duties of the offices involved should be defined to prevent possible future problems.

Is there any validity to this?

Dr. YORK. They are defined in a general way. They are defined through the job descriptions and charters of the particular offices.

In general, when a major problem comes up, I handle it on an ad hoc basis and I assign it to whomever I think is most qualified. Sometimes it is easy, for example, in the case of BMEWS, which is an air defense system, and NIKE-ZEUS, which is an air defense system. These are assigned to the Office of Air Defense.

Obviously, when you are dealing with an electric component problem, that would go to the Office of Electronics. There are intermediate situations and we judge them on the basis of which office has the most capability, the most information on the subject.

REVIEW OF FEASIBILITY STUDIES

Mr. MAHON. The report states:

Feasibility studies which form the basis for new research and development programs will not be subject to supervision by the above Office.

They referred to your Office, as you know, Dr. York.

When missions are ill defined and the services are competing for new roles and missions by displaying capability in new areas, do you think it would be helpful if your Office entered the picture at this point rather than waiting until later when the pressures exerted in behalf of the retention of a certain program would be greater?

Dr. YORK. It would be administratively simpler to do that, because, as the report suggests, finishing a feasibility study does then mean that there is a certain momentum to continue the subject further.

On the other hand, by taking a more liberal attitude and allowing the services to study most anything that their own research directors feel they should, we do get in this way more ideas; and, therefore, I have taken an extremely liberal attitude with regard to what they are allowed to study in the various forms of feasibility studies, and that is one version of this study process.

It would be administratively easier for me if I did not do that, and there would be less argument about who is going to continue with what.

On the other hand, there are more ideas produced this way and I think we are better off to accept a little bit of extra confusion and pressures to get these extra ideas.

CRITERIA FOR REVIEW OF PROGRAMS

Mr. MAHON. That is a very interesting response.

My understanding is that approval from your Office for the continuation of a research project is required only if that project involves $2 million in the current fiscal year, or if it will involve $10 million or more in the succeeding 3 fiscal years.

We have discussed that to some extent here.

Our staff report states that the $10 million in 3 years criteria can be avoided by the services merely by their estimating that a program will involve only $9 million. Is that correct?

Dr. YORK. That is correct.

Mr. MAHON. A further estimate is made that the $2 million limit will be the principal dividing line and that it will include over one-half of the money in the "Research and development" budget.

Do you agree with this estimate and do you think this will provide sufficient supervision of the whole research and development program?

Should the subject, as well as the dollars, be considered?

Would you comment generally on that whole problem?

Dr. YORK. The $2 million is a requirement and they have to come in for prior approval for reprograming which involves more than $2

million. They have to submit to us project cards on everything they are doing, and at one point or another in the program these project cards are virtually all reviewed by one or another member of my staff. The reason for making the $2 million figure had to do with a count that we made with regard to how many reprograming actions there were per year that would have to require prior approval, depending on what level we picked.

This level of $2 million involves—I would have to check this, but it is slightly better than one a week—and since our purpose is not to be a backstop or bottleneck for everything that is going on, we did not want to set this unnecessarily low. We have to work in a way that assumes—and right now I can testify that it is a correct assumption—that the service research and development organizations are composed of responsible people.

We attempt, and succeed in some measure, to work with the services rather than as a group that sits on the opposite side of some sort of a forum in opposition to them.

Mr. MAHON. In view of my comments and my questions and your statements today up to this point, I wish you would take the liberty of adding anything in the way of further clarification which might help us to evaluate this problem.

You can add that for the record, if you wish.

Dr. YORK. Yes, sir.

(The information referred to follows:)

Department of Defense instruction No. 3200.6, dated March 1, 1960, is a revision and consolidation of the program information requirements of the Office, Director of Defense Research and Engineering. In addition to the information and progress reporting required, provision is made for the prior approval of all new projects for which the cost estimate is $2 million or more for 1 year or $10 million or more during a 3-year period, and any program revision where there is a change of $2 million or more. This procedure is designed to bring into the open for top level decisions any major shifts in emphasis as well as the initiation of costly programs which would have a profound effect on program planning and budgeting in the near future.

On the other hand, the staffs of both the technical offices and the operational systems offices have the entire research and engineering program of the Department of Defense under continuous review throughout the year with additional special emphasis during the budget review from September to January and the apportionment review from June to September. Recommendations may be made, however, at any time for termination or curtailment of projects, shifts in emphasis, or the initiation of new projects to close gaps which may be uncovered in the review process. This continuous review process involves formal and informal meetings, telephone conversations, visits to field installations, demonstrations, symposia and individual or group research and study of an analytical nature. In view of the varied nature of these continuous reviews, it is not advisable or practicable to prescribe a formal review procedure.

REFUSAL TO SUBMIT REPORTS OF WEAPONS SYSTEM EVALUATION GROUP TO STAFF

Mr. MAHON. I would like to raise another question, Dr. York.

The weapons system evaluation group is under your administrative direction?

Dr. YORK. That is right.

Mr. MAHON. When our investigators requested that reports of this group be made available to the investigating staff, they were not able to secure this material.

Two of these reports involved NIKE-ZEUS in which this committee has great interest.

Do you think this was proper procedure? What is your reaction to that?

Dr. YORK. The WSEG group is under my administrative direction, but the great bulk of the WSEG group is for the Joint Chiefs of Staff. Therefore, the procedure I use—and I am sure it is right—is that matters of this sort are really the prerogatives, or it is a question for the Joint Chiefs.

WSEG is a service which I supply to the Chiefs and the product of WSEG really belongs to the Chiefs and not to me unless it is a study I have requested.

REFUSAL OF STAFF OF JCS TO TALK WITH COMMITTEE STAFF

Mr. MAHON. As I understand it, the investigators were denied an opportunity to discuss these problems with the officials who are in the Joint Chiefs of Staff?

I do not mean the members of the Joint Chiefs, but the staff members of the Joint Chiefs.

What is the background on this?

Dr. YORK. I believe that is a Joint Chiefs of Staff ruling or regulation.

Mr. OSTERTAG. You mean a ruling that they cannot discuss this subject matter?

Dr. YORK. These reports belong to the Joint Chiefs and they are very close with these reports. I think, probably, properly so.

In general, they have very limited distribution within the Department of Defense.

Mr. MAHON. Our investigators could not see the reports and they could not interview the people who worked in connection with the reports. I am just raising this issue as to whether it was proper or not. It hampers the efforts of those employed by the committee to do investigating work.

Mr. FLOOD. Mr. Chairman, I think the record should be very clear as to exactly what this point is. You personally made it very clear in your statement on the floor last year to the House in reporting this bill, and the report for this committee made it equally clear. At some time or other most of the members of this committee, and I, certainly, have reiterated time and again the great lack of confidence we have in the Joint Chiefs of Staff over a period of several years as a result of evidence given to us by individual members of the Joint Chiefs on extremely important matters of policy decisions or rather lack of them or debate of them.

I have in mind aircraft carriers, and other things.

Now, as a result of that, and as a result of this acute and repeated dissatisfaction by this committee with that conduct in the Joint Chiefs of Staff, this committee directed or requested the Appropriations Committee to set up an investigation. Among one of the chief things we wanted a report on was the premise you state.

Yet the investigators of this committee went down there to examine this premise and the Joint Chiefs of Staff ruled that the investigators of the Appropriations Committee could not talk to the personnel of the Joint Chiefs of Staff about this very thing.

Mr. MAHON. And could not review the reports and records.

Mr. FLOOD. It is outrageous.

Mr. MAHON. One of the things which we are seeking to do in this operation—and we do not question the integrity of the members of the Joint Chiefs—was to check their procedures and determine whether or not actually the Joint Chiefs of Staff did give consideration to certain problems.

Dr. YORK. The question of these reports and access to them is something that does not fall under my purview, Mr. Chairman.

Mr. MAHON. I would like to read from the report as follows:

The Joint Chiefs of Staff have advisers in operational direction of the Armed Forces and have numerous responsibilities in the areas of strategy and logistics of particular interest to this staff. Our staff making the investigation had the prescribed function of reporting on programs of scientific research and development to the Secretary of Defense. Advice was received from representatives from OSD and personnel with JCS that interviews with JCS personnel would not be permitted. Consequently, the staff was unable to determine the types of reviews given missile programs by the JCS.

The meat of this thing is that we wanted to see to what extent the Joint Chiefs of Staff made a study and review of missile programs. We were not able to do it and we feel that this was not good.

Mr. FLOOD. Of course, at this point I would like to bring to the attention of the subcommittee that they request at the next executive session of this subcommittee, in which we report on these problems and this bill, that we take further action, or decide what further action, if any, is to be taken as a result of this attitude of the Joint Chiefs of Staff on this question.

Mr. OSTERTAG. Mr. Chairman, may I comment?

Mr. MAHON. Yes.

Mr. OSTERTAG. It would seem that this report and the problem we are discussing would be directly associated with the Joint Chiefs of Staff rather than Dr. York and his office.

Mr. FLOOD. There is no question about that. It is related to his problem and I raise the point now because it is raised now.

Mr. MAHON. Mr. Ostertag raises the point, and very properly so, that this matter, while it can be discussed with Dr. York with respect to WSEG, could be more appropriately discussed with the Joint Chiefs of Staff.

We did not have the report of the investigative staff before us at the time General Twining and the Secretary of Defense were before us and I am going to ask that that colloquy be called to the attention of the Secretary of Defense and the Chairman of the Joint Chiefs of Staff, with a view that some way be found to surmount that difficulty which we encountered in our report this year.

Mr. OSTERTAG. I think so, too.

Mr. THOMSON. Mr. Chairman, I think your statement clarified it for me, but my understanding is that, and my idea was that, there was no lack of confidence in the Joint Chiefs of Staff, but a lack of confidence in whether or not they were implementing the system.

Mr. MAHON. Yes.

Mr. THOMSON. So as to make it effective as a review and give direction to our military programs.

Mr. MAHON. I believe that statement is completely correct.

Mr. FLOOD. My position goes a little further than that. My position in the case is lack of confidence in the Joint Chiefs of Staff when they do not debate, as Joint Chiefs sitting as a corporate body, these matters of policy on weapons systems, which they said to us they did not debate.

Mr. MAHON. That is another facet of this question.

Mr. FLOOD. That is right.

Mr. MAHON. That is an important facet, but that is not what I had in mind.

Mr. THOMSON. That is what I had in mind. It is the operation the system to get these decisions made by the Joint Chiefs of Staff. We do not lack——

Mr. FLOOD. I would agree with that.

Mr. THOMSON. We do not lack confidence in any individual.

Mr. FLOOD. Oh, no.

Mr. SHEPPARD. I found the same experience of having a door closed. It is not confined specifically to the Joint Chiefs of Staff. If you try to get information and reports on the Inspector General's Office, see how much luck you have there. They told us frankly and briefly that these reports are for the exclusive use of the respective services and the Secretaries they serve, unquote.

Mr. MAHON. Mr. Sikes?

SCREENING OF PERSONNEL

Mr. SIKES. Dr. York, I note from your statement that you have added a number of Assistant Directors. I do not quarrel with you about that, but I would like to ask you how you manage to screen personnel in order to be sure you are getting adequate help in this very difficult and very important job which is before you?

I want you to go just a little further. Congress has generally made available to you all of the money that has been requested. Congress has been very anxious not to let cost be a limiting factor in this field.

You have an agency that has been expanding. Those of us who have been around here for a while know that unless there is very careful screening, you can get people abroad who are just going along for the ride. We have seen this instance many times here when bright young people in the Government switch to a new agency whenever they can, because usually they get a promotion if they change agencies.

All of those things are gimmicks that are familiar to civil service personnel. Probably you cannot screen all of the people you employ. How carefully is the job done in order to insure you get the most capable people possible to help with this work?

Dr. YORK. Mr. Sikes, I have not added very many people.

Mr. Huff was getting the statistics for me on how many we have added. Since I came on board we have added 65 people and of these, 15 are military people; about 20 are clerical people and if these figures are right, that means we have added about 30 professionals in the civilian category professional.

I have personally reviewed and recruited most of the professionals. I did not recruit all of the military, but I personally selected the senior military officers. I have had a great deal of outside help and, in

particular, from Dr. Killian and Dr. Kiastiakowsky, and others, whom I believe to be very reliable in matters of this sort.

For example, Mervin Kelly, president of the Bell Telephone Laboratory up until he retired last spring, and Mr. Lawrence Hyland, who is the president of Hughes Aircraft, just to pick another name out.

It was on the recommendation of people of this caliber that I first approached most of these people and then I talked to them myself, or my deputies talked to them, and some of the others in the office. I also got further recommendations.

My own activity in this line was largely all by conversation and there is no record of it.

Moreover, all of these people went through the standard civil service and security processing.

They were handled in the regular way and, therefore, there were letters of recommendation, review of past records, and so on.

So, the formal procedures, performed the usual screening function. I, personally, recruited nearly all of the, or most of the, added professionals.

RECRUITING OF STAFF

Mr. SIKES. That is reassuring. Have you had any difficulty in securing an adequate number of personnel of the high type you need for this work?

Dr. YORK. Yes, it is always difficult.

It is decidedly a real job.

Mr. SIKES. In your statement on page 6, you say," * * * While we are admittedly behind the Russians in the development of very large thrust boosters * * *" and so on——

Mr. MINSHALL. Before you leave that point, what have you done to recruit people from various outside sources? What active measures have you taken to do that?

Dr. YORK.- I have, as I have mentioned in answering Mr. Sikes, gone to Dr. Killian, Dr. Kiastiakowsky, Dr. Kelly, and others I know, and who know technical people, to try and locate people that could come and join the staff. Most of the people that I have recruited are not permanent people.

I do not know what word to use, but they are people who were in industry or universities and people we have persuaded to come in and help us out for as long as they can.

Mr. SIKES. Your personnel are not required to come from Civil Service rolls?

Dr. YORK. No.

Mr. SIKES. But you do follow Civil Service procedures?

Dr. YORK. Some, in fact, have come from Civil Service sources but they are all hired through Civil Service procedure.

Mr. MINSHALL. Has industry, by and large, cooperated with you in this regard?

Dr. YORK. I have a great deal of help from them in industry.

Mr. MINSHALL. Have there been any instances where they have not cooperated?

Dr. YORK. No; that is hard to answer. If someone does not know somebody, or if I do not get help from someone, that can mean he does not know anybody or has nothing to suggest.

I would not say that anyone I have approached has failed to cooperate.

I have not gotten results from everybody I have approached.

Mr. SIKES. I think there still is some question about just what part Civil Service plays in this. You are not limited to personnel on Civil Service rolls, but your people are hired by Civil Service after you select them for a specific job; is that it?

Dr. YORK. That is correct.

DEVELOPMENT OF LARGE THRUST ROCKET ENGINEERS

Mr. SIKES. Going back to my question about the development of very large thrust boosters, when that is discussed here, some say, "Well, the Russians started first, and they started the development of large thrust boosters because they were interested in space, while we were thinking about a more limited operation, purely defense operation."

Is that the true picture? Is that what happened?

Dr. YORK. I do not think it is quite that, Mr. Sikes.

They and we both began large rocket programs at a point which was early in the nuclear weapon development programs in each country. I believe it is correct that they started theirs at a time which, relative to their nuclear weapons program, was earlier than when we started ours, relative to our nuclear weapons program, as well as being earlier absolutely.

They had to make the same kind of estimates that we did. How big? What is the weight of the necessary payload?

In our case, this was done in 1954—that, I think, is the correct date—by a committee headed up by the late Dr. John Von Neumann, who was later one of the Atomic Energy Commissioners.

In the course of this meeting we settled on a number. We had the benefit at that time of roughly 3 years, let us say, of design study of thermonuclear weapons and some similar occurrence took place in the Soviet Union. My guess is that they settled on a larger number because they were less far along in the development, had less information on which to make predictions about what payloads could be, and perhaps took a more conservative approach. There is a lot of guesswork involved in that, but I know that in our own case, that is how it was done.

By coincidence, I was involved myself and, in fact, the ATLAS version was largely a paper study that had existed prior to 1954 and would have carried about twice as big a payload as the present ATLAS will. The size of the ATLAS was deliberately cut in half because it led, by picking a lighter warhead, to a similar rocket, fewer engines.

The ground equipment would be simpler, and so on.

DEVELOPMENT OF DEFENSE AGAINST BALLISTIC MISSILES

Mr. SIKES. Dr. York, I am one of those people who hopes we can develop an antimissile missile, but I, quite frankly, am one who is skeptical of our ability to do it. To be able to hit a bullet with a bullet is just a little beyond my comprehension. Yet I realize we have to try.

Do you feel that the picture on the NIKE–ZEUS is a brighter picture today than it was a year ago, or is it still a standoff insofar as anyone being able to estimate whether we should begin the actual construction program itself, rather than to continue only in the developmental stages?

Dr. YORK. I think that taking all of the changes together over the last year, you end up with essentially no change as far as that is concerned.

Mr. SIKES. But it has not changed either way significantly?

Dr. YORK. I do not think so.

Mr. SIKES. We just do not know?

Dr. YORK. No.

Mr. SIKES. When do you think we will?

Dr. YORK. That is very hard to say, of course. The thing that stands out in the future is the actual systems tests which we are planning for Kwajalein Atoll. This will take place by the time you have had many results and have had a chance to look at them.

(Discussion off the record.)

Mr. SIKES. Are you inclined to be optimistic or pessimistic in this field?

Dr. YORK. I would just as soon avoid either label, Mr. Sikes.

On this one, as I said earlier, I am not very optimistic. On the other hand, I think it is worth trying very hard.

SKYBOLT MISSILE

Mr. SIKES. I guess we are all in the same boat on that.

Tell me something about the SKYBOLT.

What will it do that other weapons will not do?

Dr. YORK. It is another member of our strategic deterrent family. It is a ballistic missile which is carried on an aircraft and, in particular, it fits the B–52 and certain British aircraft.

Its purpose is similar to the purpose of the HOUND DOG; namely, it is a weapon that can be sent out on ahead in an aircraft into an area that might be more strongly defended and in which the aircraft itself would have a hard time penetrating.

(Discussion off the record.)

In terms of other factors of performance, it is hard to say. It represents a more advanced state of the art.

On the other hand, it is longer range and the rocket is a little more difficult so that I think the best thing to say is that it is comparable in terms of accuracy with the HOUND DOG.

Mr. SIKES. What type of a warhead does it have?

Dr. YORK. I have forgotten the warhead for the HOUND DOG, but I believe this is smaller than the warhead for the HOUND DOG. I would like to check the record.

Mr. SIKES. Is it limited to any one of our aircraft inventory or can it be used in all of our strategic aircraft?

Dr. YORK. No; it is so large you cannot just transfer it from one airplane to another. Present plans call for using it on a B–52 only, but the B–52 is the backbone of the intercontinental force. Because it is a ballistic missile ——— it means that it is traveling at ——— or so, whatever it is.

Its vulnerability or penetrability of defense is obviously greater than that of the HOUND DOG which is just slightly supersonic.

Mr. SIKES. Do you foresee that it may replace the HOUND DOG or do you think there will be a place for both in the inventory?

Dr. YORK. I think it may very well replace the HOUND DOG.

Mr. SIKES. What is the state of development? Has the testing actually begun on the weapon itself?

Dr. YORK. No.

Mr. SIKES. When does testing begin?

Dr. YORK. It is more than a year off. I am not quite sure when. Experiments relating to this have been done and, for example, rockets have been launched from aircraft. I do not regard those as really terribly significant stages in the development of this weapon. It is a matter of several years.

The Air Force says it will enter the force in ——— as a follow on to the HOUND DOG. The date may be a little optimistic. These dates usually are, but not always.

The ATLAS and TITAN and THOR and JUPITER managed to be early. It is hard to generalize.

EMPHASIS PLACED ON CHEMICAL AND BIOLOGICAL WARFARE

Mr. SIKES. In a report issued by the House's Science and Astronautics Committee last July a statement is made substantially as follows:

> Today, CBR research in the United States is supported at the level of about $35 million to $40 million a year. Responsible elements in the Department of Defense believe that a progressive raising of this support over 2 or 3 years to about $125 million a year would enable the more thorough pursuit of possibilities waiting to be discovered, which they know are under such vigorous attack abroad, particularly in the Iron Curtain countries.

I wonder if you would briefly describe what the Defense Department is doing, first, to program such funds into the CBR area; and, second, to insure that the program receives the desired emphasis at all levels?

Dr. YORK. Yes.

Let me speak for myself and my own activities.

The $35 million refers to the fiscal year 1959 level. We have reprogramed, by the use of transfer authority, in the emergency fund and we have put more money into it this year.

I think the fiscal year 1961 request is $57 million for that field and we may increase the program further. I feel, and certain experts on my staff in this and related fields feel, that in terms of meeting military requirements, there is a tremendous promise in this field.

If we push it, its influence in warfare could be comparable with that of atomic energy. One of the things that has bewildered a lot of people and still bewilders us is the fantastic variety of things that can be done. At one extreme you may be able eventually to achieve an area covered per sortie which is greater than what can be achieved with nuclear weapons. It is the per sortie capability that is ultimately important. As to the other extreme, this field of CBR includes the development of superior tear gases, such as are used in prison riots and could be used effectively against mobs anywhere, without causing any deaths at all.

They may be usable in grenades, thrown by a single soldier. You can make them both bigger and smaller than atomic bombs. Atomic bombs can only be made so small because of the critical mass required, but in the case of chemical and biological weapons, you can continue to make them smaller and smaller, both in physical size and effect.

The kinds of effects will eventually vary from instant death at the one extreme, which is, of course, what the atomic bomb attempts to achieve, and what a bullet attempts to achieve, down to temporary incapacitation where the people are caused to faint, or they are caused to lose their will to fight, or they are caused to lose their coordination, or they suffer sufficient discomfort so that their only objective is to get out of there right now.

Mr. OSTERTAG. Will the gentleman yield?

Dr. YORK. This applies to both biological and chemical weapons. Eventually we will have the option of producing these incapacitations either right now, and for a few hours, or delaying the onset of incapacitation in a few days after which the effects may continue. The possible potential variety is just fantastic.

Mr. OSTERTAG. Off the record.

(Discussion off the record.)

Mr. SIKES. To me, the lower cost of CBR, combined with the potentialities for effective use which you have outlined, should make it a most important field. The cost in this field is less than that in other fields of warfare, are they not?

Dr. YORK. If you look at cost effectiveness for producing a casualty, whether lethal or temporarily incapacitating, they are, very roughly speaking, comparable with nuclear weapons.

It is my feeling that if a comparable effort were put on this as has been put on nuclear weapons, that comparable results, or perhaps even greater results, would be achieved.

Your point was the cost of these systems?

Mr. SIKES. For instance, R. & D. expenditures in CBR are among the lowest of any major branch of the services—although it has great potential. Is it not also true that the cost of CBR weapons is small in comparison with the cost of other weapons.

Dr. YORK. Well, if you want to cover the same number of square miles, they are, very crudely speaking, potentially comparable with atomic weapons.

By "crudely," I mean with the present chemicals, by the time you have taken into account the delivery system required, they may be 10 or 100 times more expensive.

Down the road, I can see the possibility they might be 10 or 100 times cheaper but within that enormous range of, let us say, 100 either way, they are in the same class potentially as nuclear weapons except that with nuclear weapons there is a smallest size, and then no smaller, whereas with these you can keep on making them smaller and smaller. Also, with nuclear weapons, you cannot get nonlethal effects, but only lethal.

Mr. SIKES. I have been impressed and encouraged by the fact that it is possible to avoid destruction of buildings, bridges, and other facilities by the use of CBR which cannot be done with other weapons.

Dr. YORK. That is right. You can also remove the effectiveness of people without killing by use of nonlethal agents.

Mr. SIKES. In view of the things that have been said, do you feel that at the current rate of expenditure, we are proceeding rapidly enough to explore the capabilities of CBR?

Dr. YORK. No; that is why we are expanding the program. On the other hand, we probably cannot expand much faster than we are. You can always try a little harder and expand a little faster, but we are in the research phase now and attempting to expand this program and are doing so.

I have the figures here for fiscal 1960, $44 million; fiscal year 1961, $57 million; and $44 million is already being augmented by the emergency fund and that may well happen again in 1961.

Mr. SIKES. I have been highly pleased by the reports I have received of the support you are giving to the field of CBR. I have been deeply concerned in the past by what I have felt is inadequate appreciation and awareness of chemical and biological weapons. I have not felt that we have taken advantage of potentials of these weapons and what they offer, and their overall military capabilities, nor do I think we have built up the necessary defenses against their use by an enemy.

It appears to me that we may be particularly vulnerable in this field. Do you agree that we may be particularly vulnerable to attack in this field?

Dr. YORK. Yes, I do.

Incidentally, in all categories of defense, on the battlefield as well as in the civil field, in every aspect of this program we believe the Soviets are working considerably harder than we are.

Mr. FLOOD. Would the gentleman yield?

Mr. SIKES. Yes.

Mr. FLOOD. Do you include decontamination as well as the other elements? Battlefield decontamination and other?

Dr. YORK. You not only have decontamination but masks, protective clothing, and medical treatment.

Mr. FLOOD. I mean specifically decontamination as well as area——

Dr. YORK. Decontamination is included here.

Mr. OSTERTAG. Doctor, in connection with our civil defense, we hear about shelters from radio active fallout and other means of protection, but I have yet to recall that gas masks, as such, should be part and parcel of our civilian defenses and used by, and be available to, all people.

What do you think of this?

Dr. YORK. I believe your statement is correct but I am not personally very well informed on that.

Mr. OSTERTAG. What I mean is, does it not seem to you that the use of gas masks might be a means of protection?

Dr. YORK. Yes; I actually am somewhat more concerned about the possible battlefield use and the lack of battlefield defenses in this area.

At the present time, thermonuclear weapons are such an effective means of attacking a continent, such as the continent of North America, for the Soviets that I would suspect their interests in chemical warfare were more with respect to limited war than general war at the present time.

These things are always subject to sudden change.

PROBLEMS IN BOMARC DEVELOPMENT

Mr. SIKES. Dr. York, I would like to talk to you about BOMARC for a few minutes.

BOMARC appears to be in about the same status as ATLAS was a few months ago.

However, I believe there are more people who feel that BOMARC is not going to come out of this slump that it currently is in, than was the case with the ATLAS when it was having its troubes. We have a great deal of money invested in BOMARC and it has been considered as an important part of our defense program. If we can make it work, we should do so, in view of the investment, if it has the capabilities that were associated with it originally.

Do you feel free to express an opinion?

Is this a weapon that is going to be able to do the job that was anticipated?

Dr. YORK. I think it can be made to work, yes.

General Schriever has set up a special review of that program to investigate the accident that occurred in the case of the very last shot and make recommendations for the future. I am confident that General Schriever will give it the review that it needs.

OBSOLESCENCE OF BOMARC

Mr. MINSHALL. You say you can make it work, but when? It will be outmoded before we get it into the inventory?

Dr. YORK. Not by a competitive weapon system.

Mr. MINSHALL. It is not fair to compare it to the ATLAS. It is another class of weapon.

BOMARC will not be in the inventory a long time.

Dr. YORK. You are talking now about the operational requirements?

Mr. MINSHALL. That is correct. It is a question of making it work, but it is not going to work in time.

Dr. YORK. I think the BOMARC issue should be argued on that basis, rather than on strictly a technical basis.

Mr. MINSHALL. You agree with me then that it is going to be outmoded before we can get it in the inventory?

Dr. YORK. There are people who argue that that——

Mr. MINSHALL. What is your personal opinion? I am asking you.

Dr. YORK. The question of what is needed is a question of what is needed for air defense at what time in the future.

Mr. MINSHALL. You are evading my question. What is your opinion? Do you believe it will be outmoded before we get in in the inventory or not?

Dr. YORK. It may, but not because of the technical difficulties it is now in.

Mr. MINSHALL. What do you mean by that?

Dr. YORK. I mean that it is a rapidly moving world and missiles are rapidly becoming the principal threat.

Mr. MINSHALL. BOMARC is no defense against missiles.

Dr. YORK. It has no effect against missiles.

Mr. MINSHALL. Absolutely none.

Then it will be outmoded even before we ever get it in the inventory, even if everything went fine for the next——

Dr. YORK. This is an issue which is under active discussion.

Mr. MINSHALL. What is your opinion?

Do you think it is going to be outmoded? Do you not honestly feel——

Dr. YORK. I do not think it is going to be outmoded. The question is not so much of being outmoded. The question is where do you put the primary emphasis?

Mr. MINSHALL. You can put it in the Smithsonian Institution.

Dr. YORK. It will not be outmoded until the Soviets abandon their air force.

The question is, how important is it to work on the threat of their air force as opposed to working on other things?

COST OF BOMARC

Mr. FLOOD. Let me point this out to you: You have always been very careful in any statement you make or any answer you give to a question. You never fail to put in your equation—never, and it is a commendable thing and I noted it particularly with you and not with other witnesses—you never fail to crank into your equation the very important element of cost; you never fail to introduce that element and until you talked to my friend about BOMARC you made a point of leaving that out.

Dr. YORK. Well, the question is not a technical one. The question is not by any means entirely a technical question. The primary problem with BOMARC and I believe it was the——

Mr. MINSHALL. It does not work.

Mr. FLOOD. You are talking to me?

Dr. YORK. Yes, sir; excuse me.

Mr. FLOOD. You have said that three times. I suggest to you that there is an element of $4 billion in this on the day it is operational in 1963, if all of these other things are equal. In the years you have been before this committee, you have never failed, and would never fail, to inject into your equation at any time, on any system, the element of $4 billion. You make a point of that and it is a commendable point.

Even when I bring it to your attention, you persist in ignoring it in this case of BOMARC and persist, I might point out.

Dr. YORK. It is a deployment question, really.

What I was trying to say is that this question should not be discussed in terms of what has been happening to these technical——

Mr. FLOOD. I am not discussing that.

Mr. SIKES. I am for BOMARC. You gentlemen may be against it, but be against it in your own time.

Mr. FLOOD. I thought you were going to abandon both the subject and BOMARC.

Mr. MINSHALL. We thought we had you convinced.

MOBILE LAUNCHING SITES FOR MISSILES

Mr. SIKES. I know time is running short, but let me ask you this: According to the best information we can get, we are not stressing

the development of mobile launching sites for missiles to an extent comparable to that which the Russians are said to be stressing developments of mobile launching sites.

Could we not do more in this field, and do you think it is important we do more?

Dr. YORK. We are doing quite a bit, Mr. Sikes, and in connection with the MINUTEMAN, there is a plan for putting the MINUTEMAN on trains. The POLARIS is a mobile system, a mobile system at sea, and we are studying the possibility of a land-based——

Mr. SIKES. I am thinking about the use of railroads and trucks to achieve mobility.

Dr. YORK. We plan to put the MINUTEMAN on rails. The POLARIS, we are looking at a mobile system for that and that could possibly be by truck.

Mr. SIKES. The Russians are said to be placing stress on the use now of mobile sites, railroads, particularly, for their launching sites. If so, that makes it extremely difficult for us to target those sites.

We do not seem to be doing anything significant in that field. We are using fixed sites except for the MINUTEMAN and our newspapers have been publishing maps showing those fixed sites.

Dr. YORK. The earliest that we can do it is in the MINUTEMAN program.

Mr. SIKES. Why? Because it uses solid propellant?

Dr. YORK. The ATLAS and the TITAN are just too bulky and complex to make mobile.

Mr. SIKES. How is it that the Russians can develop mobile sites for their current ICBM's which carry bigger payloads?

Dr. YORK. Well, that is a debatable point as to what they are doing. There is mobility and there is also transportability.

In the smaller missiles, such as on the PERSHING, right from the start it will be mobile. It is just that the state of the art on big missiles in this country does not really permit mobility before the MINUTEMAN.

Mr. SIKES. Do you foresee that the MINUTEMAN can be launched from trucks, or would it be confined to railroads?

Dr. YORK. The MINUTEMAN is too heavy, really, for trucks.

Mr. SIKES. What about the PERSHING?

Dr. YORK. The PERSHING will be launched from trucks.

Mr. SIKES. Not MINUTEMAN?

Dr. YORK. Not the MINUTEMAN.

A follow-on missile, which is still smaller, could probably be built and could be truck-mobile.

Mr. SIKES. You are not convinced that the Russians are using mobile sites, railroad launching sites, for their ICBM's, then?

Dr. YORK. No; not convinced.

Mr. SIKES. IRBM's?

Dr. YORK. I do not really know, Mr. Sikes.

Mr. SIKES. Thank you very much.

Mr. THOMSON. Mr. Chairman? May I ask the witness a question?

Mr. SIKES. Yes.

REPORT COMPARING ATLAS AND TITAN

Mr. THOMSON. Are you familiar with the so-called Doll report by the vice president of the Space Technology Laboratory?

Dr. YORK. I do not know of a report by that name. I know Mr. Doll very well.

Mr. THOMSON. Are you familiar with the report that compares the ATLAS and the TITAN?

He has been presenting that around the Pentagon, has he not?

Dr. YORK. I have talked at considerable length with Mr. Doll about that problem. I have not read that report.

Mr. THOMSON. Do you have a presentation of that report?

Dr. YORK. Not a formal one.

Mr. THOMSON. Can you get copies of that report to bring with you this afternoon, one copy to be left with the committee?

Dr. YORK. I really do not know whether I can or not.

Mr. THOMSON. Would you make your best effort?

Dr. YORK. I will look into it.

That would be a report to the Air Force?

Mr. THOMSON. Yes.

Dr. YORK. I will check with them on that. Actually, Dr. Charyk will be here within a day or two.

Mr. THOMSON. I would rather go into it with you, since you discussed it in your statement.

Dr. YORK. I am perfectly happy to go into this discussion with you, but Mr. Doll works more directly for Dr. Charyk than he does for me. However, I am perfectly willing to discuss it.

Mr. THOMSON. I would like to see it.

I have heard so much about it but have never seen it.

Dr. YORK. I am not even certain that such a report exists. If you know it does, I am sure it does.

Mr. THOMSON. You do your best and I will do my best.

Dr. YORK. What bothers me about this is that I understand such a report is due in April and so I do not know——

Mr. THOMSON. Off the record.

(Discussion off the record.)

Mr. SIKES. Thank you very much, Dr. York.

We shall reconvene at 2 o'clock.

AFTERNOON SESSION

Mr. MAHON. We will resume the hearing. I believe Mr. Flood has some questions.

RANGE OF B–52G AND B–52H

Mr. FLOOD. Dr. York, in your statement there was a line to the effect that the latest models of the B–52—I suppose you meant the B–52G and B–52H——

Dr. YORK. Yes.

Mr. FLOOD. Can reach any target in Russia with the new fan prop, and so on, without refueling.

Dr. YORK. Not any target, Mr. Flood, but many targets from many bases.

Mr. FLOOD. Do you mean and return without refueling?

Dr. YORK. Yes, for many of the cases.

Mr. FLOOD. From continental United States and return?

Dr. YORK. Yes; to places which are near enough.

Mr. FLOOD. That is safe enough.

Dr. YORK. I am sorry; I meant to get but I do not have the details on that. I could get them for you.

Mr. FLOOD. Yes. I just want to be sure what you mean. I want to know that the addition of this fan is going to be of such vast importance that the latest models of the B–52, with the QUAIL and the HOUND DOG, can go to what areas and return without refueling. This is important because of the tanker program.

Dr. YORK. Right.

Mr. FLOOD. If we can go to nearly all of the areas concerned with QUAIL and HOUND DOG and return without refueling——

Dr. YORK. That is not the case, nor is it from all bases in North America.

Mr. FLOOD. Suppose you let the record show, whatever record we are going to use, the extent of this program under this new and extended B–52G and B–52H, the latest generation.

Dr. YORK. Specifically with the turbofan.

(A classified statement was submitted.)

WITHDRAWAL FROM SEAWARD EXTENSION OF THE DEW LINE

Mr. FLOOD. We spent some time this morning talking about the warning systems and the various satellites such as MIDAS and SAMOS and BMEWS, et cetera, for different reasons and different purposes. You are aware of the Navy pulling out their ships in the Atlantic and Pacific on the SAGE system, are you not?

Dr. YORK. Yes.

Mr. FLOOD. The Air people claim they were quite surprised about it and the Air general said he had not been consulted about it. I take for granted the Navy had talked to somebody in Defense about it, that they just did not do this unilaterally under the force structures we have.

I do not know the facts. What are the facts? What happened? What is the significance to the SAGE system? We were present for the accouchement of the SAGE system, grew up with it, went all through it, et cetera. You say in your statement it is about finished and at the point when it is about finished the Navy pulls out their ships, port and starboard, and the Air people say there is a big hole port and starboard which they cannot fill. What kind of nonsense is all this?

Dr. YORK. This is an issue that does not really properly come under my office, although I know a little bit about it.

Mr. FLOOD. Just whatever you know.

Dr. YORK. This is the seaward extension of the DEW line that is under question here. It is in both oceans. In both cases there are two DEW line extensions. There are the airborne early warning radar aircraft and there were the destroyer-mounted radars. They were in essentially the same area and performed the same function. That is, they were to catch aircraft that were coming from the Soviet Union to-

ward North America and in this case avoiding the land part of the DEW line by coming either across Newfoundland and across a line between Newfoundland and the Azores or across a line connecting Alaska and the Hawaiian Islands, but there were the airborne and seaborne components.

It again was one of these issues where there was a question of how best to put resources, the best way to use resources. The question was studied, I believe, probably by the Chiefs as to whether or not you could get rid of one of these. If so, which one. In a sense, they were duplicative. They do not do precisely the same things. The destroyers have a problem with low flying aircraft coming between them because they are at sea level. The aircraft are at higher altitudes and in principle can cover a larger altitude range. On the other hand, there is a more serious station keeping problem with the aircraft.

It was the conclusion of the Chiefs—I am a little surprised that NORAD says they were not consulted, but I do not know to the contrary—it was the conclusion, I presume, of the Chiefs that of these two the destroyer line was the least essential.

I do recall that they were about equally expensive, talking now within 20 or 25 percent, and had about equally heavy requirements in manpower.

Mr. FLOOD. There was a requirement for it because it was all justified before us, and the Navy came here and all the DEW line people and showed us at great length over a series of years how essential and necessary all this was. Now all of a sudden it is not.

Dr. YORK. There are changes, there are improvements on our side with respect to other radar systems on the shore for detecting incoming aircraft. There are other systems coming in or in being for improving interception probabilities. Also, there is the change in our estimates of the Soviet air threat.

Mr. FLOOD. Mr. Chairman, this is of such strange and peculiar significance, in view of the record of DEW line, that I would suggest you might want to inquire for the committee how this was evaluated, who made the decision, why were not the Air people consulted, just why was this done. This has been of such importance to us down through the years. Here we have a hole allegedly in the Atlantic and in the Pacific on the surface for this DEW line protection. The ships are pulled out. Why were they pulled out? Who decided to pull them out, et cetera? I think the committee would like to know. I suggest you inquire for us.

Dr. YORK. It is not so much a hole as it is a decrease in the completeness of the coverage.

Mr. FLOOD. Whatever it was, it was something. In other words, this subcommittee no longer has what we though we had. Why?

Mr. MAHON. We will go into that. I think that is a good point.

ELECTRONIC COUNTERMEASURES

Mr. FLOOD. Can you tell us something about the developments in jamming and counterjamming? How do we develop this whole spectrum of jamming and counterjamming with reference to bombers and everything?

Dr. YORK. I cannot tell you very much in detail, but we have extensive programs in both aspects, how to handle enemy jamming or,

more generally, enemy countermeasures, which include jamming and any other kinds of techniques for confusing our air defenses or our detection radars.

There are programs in all the services, because there are antiaircraft weapons in all the services, with regard to this. For example, in HERCULES there is a radar frequency diversity program, the purpose of which is to be able to give the HERCULES a choice of frequencies and a capability for moving from one frequency to another, which is so fast and of such nature that a jammer cannot follow it, for instance.

With regard to what we do, this is one of the things which the services put the very highest security on because these are operational techniques for how to penetrate the Soviet Union. Let me just say that one of the major programs in all of our aircraft weapon systems—B–52, B–58, B–70—has been the invention and then the supply of electronic countermeasures for these aircraft. This is something which is never solved. There is a continuous game between the technicians on each side to see who can do the best.

Then, in addition to these programs for development and the procurement and installation of equipment, we run every once in a while trial exercises. There were some experimental trials involving the Navy and Air Force in the Atlantic a few months ago. Then there was the one of last year involving the test of the air defenses in the Chicago area. Right now the Chiefs are considering, the Chiefs working with WSEG and with the North American Air Defense Command are working out another exercise of the air defense system. One of the major components of these exercises has to do with jamming, antijamming, countermeasures, and counter-countermeasures problems.

Mr. FLOOD. Will these products lend themselves to the Voice of America broadcast in any way, the techniques, the results?

Dr. YORK. Not as far as I know. I was generally speaking of this. The most crucial part of the problem to us—at least what I was discussing—has to do with radar detection and the prevention of radar detection, confusion of radar.

Mr. FLOOD. To what extent are you attempting to translate this technique and its refinements to the jamming and the counterjamming of field tactical weapons, radio interference on controls of field tactical weapons, both friendly and enemy? That is becoming of increasing importance because of the emphasis I like to place upon so-called limited war.

Dr. YORK. The things I am most aware of are the things we are doing with regard to how the enemy might jam our equipment and how we might accidentally jam our own. We have a rather serious problem of mutual interference in the electronic environment.

LACROSSE MISSILE

Mr. FLOOD. Let me put these two questions together. I asked that last question because I now want to ask you the next one. You can answer them both together.

We have been concerned over a period of years with the slippage and the poor performance in the R. & D. of the Army weapon

LACROSSE, with which the Marines became tremendously interested. That brought me into the picture with considerable interest. Year after year after year I have been watching this LACROSSE pigeon, which, in my judgment, has turned out to be a turkey.

Finally, the Marines gave it up. Then, to my amazement, the Army decided to keep it. We asked the Army why, this year, and they gave us reasons why, General Lemnitzer. When the Marines came in a week later, I revived the interrogation. I have this language from the Marines. The evidence shows that ——— shots were made and they could only get ——— off the ground. The Army evaluates the weapon at ——— percent, the Marines evaluate it at ——— percent. The cost is ——— per round without the warhead.

The Marine position is unanimous, flat, complete, blunt, and there are other words I could use.

(Discussion off the record.)

Mr. FLOOD. In spite of that, the Army are shipping two battalions to West Germany this month. What about this bird?

Dr. YORK. I do not know what the reason is for this difference.

Mr. FLOOD. Off the record.

Dr. YORK. I would have to check with my tactical warfare people.

Mr. FLOOD. Do not check with the Army.

Dr. YORK. I will check with mine.

Mr. FLOOD. Let us have something on it. As far as I am concerned, I would not give them a penny for it tomorrow morning, after what the Marines told us. I would not have it in the arsenal, would not have it around.

(A classified statement was submitted.)

DEVELOPMENT OF VERTICAL OR SHORT TAKEOFF AIRCRAFT

Mr. FLOOD. You mentioned, and I have great interest in this Convertiplane concept, especially for the Army and the Marines.

Dr. YORK. VTOL or STOL?

Mr. FLOOD. Yes. I am interested myself greatly in the so-called limited war aspects, all phases of it. In your direct statement you paid some attention to this concept. Can you tell us something beyond these two or three sentences?

Dr. YORK. Not much.

Mr. FLOOD. About your target, et cetera.

Dr. YORK. Our target is to determine, first of all, what a good program in this field would be for the purposes of tactical mobility.

Mr. FLOOD. You are not playing games, you are serious?

Dr. YORK. Yes, I am serious. The Army and the Navy are both interested in a VTOL or possibly an STOL, not including helicopters.

Mr. FLOOD. Why is the Navy interested; for the Marines?

Dr. YORK. Yes; for use in connection with augmenting tactical mobility. The Air Force is interested in VTOL or, more probably, STOL, from the point of view of using this aircraft for close ground support, essentially a tactical fighter.

We are really talking about two distinctly different types of aircraft here and possibly more; it might conceivably eb more than one type for the Army.

I have had a committee working for the last several months to try and determine what is the state of the art with respect to the possibilities in vertical or STOL.

Mr. FLOOD. This would be a rugged craft?

Dr. YORK. It has to be rugged enough for field use.

Mr. FLOOD. Without airstrip landing in operational areas, tactical areas?

Dr. YORK. VTOL means literally no airstrip at all; STOL means a short airstrip. In general, STOL is simpler and you can predict that at any time in the future, in terms of payload and performance of the airplane, you will always be able to do a little better with STOL than VTOL.

Mr. FLOOD. I am interested in VTOL at this point.

Dr. YORK. There is always going to be some tradeoff. Literally having to be "V" instead of allowing a little "S" will always cut in.

Mr. FLOOD. What is the range?

Dr. YORK. The purpose of the study is to try to review the state of the art with regard, for example to powerplants, what is the thrust-to-weight ratio we have now, what can we expect in the future from things under development? In other words, I have a technical panel working on the question of the technical possibilities.

Mr. FLOOD. This is a current, serious, deliberate, planned program on both STOL and VTOL for this program?

Dr. YORK. Three things are going on. I have this study for the purpose of determining the technical state of the art and providing us with outlines of what it is we can expect to do and what we cannot do. That is in my Office.

I addition, I have another study group which is phased to come in toward the end of this, and I do not know if they have had their first meeting yet or not, but it is about now, whose purpose it is to review with the Army what it is the Army would like to do, and the Navy, what they would like to do from the point of view of operations.

The objective, then, is to put these two together and make up a program. In anticipation of that, I have already attempted and succeeded in making sure that there would be money in the 1961 budget to cover these programs.

UTILIZATION OF BERYLLIUM

Mr. FLOOD. I have been interested for several years in utilizing the metal beryllium for any of a number of different things such as airframe, casings for missiles, et cetera. Are you progressing and, if so, to what extent, with this problem of the fracture point of beryllium for structural purposes?

Dr. YORK. We have several programs going on in our general overall materials program with regard to the properties of beryllium and how to improve them. To my knowledge—and I could be behind on this point—it still is not to the point where you would want to use it as structural material in any kind of craft where you had long-term vibration problems. It is being introduced in a number of special places. It is being introduced into guidance equipments.

Mr. FLOOD. I know about that, but I was chiefly concerned about utilization in structural things.

Dr. YORK. You realize it is extremely expensive at the present time. It costs about $100 a pound.

PNEUMATIC CONTROL DEVICES

Mr. FLOOD. Will you tell us, without my examining you or leading you, because you know the problem, we talked about it yesterday—I asked you to be prepared to tell us something about this new process which is to be substituted perhaps for certain areas of electronics. What is the theory of the thing, how practical is it, where are we?

Dr. YORK. You are speaking of these pneumatic control devices that are being worked on at the Diamond Ordnance Fuse Laboratory?

Mr. FLOOD. That is correct.

Dr. YORK. These are small mechanical devices that work with streams of air, streams of fast-flowing air, in a fashion which is analogous to where the streams of electrons are controlled in an electron tube so that these devices, which can be made in various sizes, including very small—and by very small I mean the size of a pencil eraser, perhaps—what you have here is a pneumatic equivalent of an electron tube. It is not equivalent for all possible purposes, but you can, for example, build with these the equivalent of what we refer to as a flip-flop circuit, a basic unit in a computer. You can build oscillators, which means they generate high frequency signals.

Mr. FLOOD. Does that a potential for substituting for moving parts in automotive equipment, and so on?

Dr. YORK. They have a number of equivalences to electron tubes and they can be substituted into control circuits where normally electron tubes are used.

They can in principle be used in any case where you want to take a small mechanical motion and amplify it into a large one. For example, you could imagine they might play a role—you mentioned automobiles—in connection with power steering or power brakes or something like that. However, the program at the present time is designed to determine the fundamental properties and the basic science of these devices and is not designed for the present to look into specific applications.

Mr. FLOOD. Are we approaching an area of some kind of breakthrough in some area of science that is material?

Dr. YORK. I cannot tell. This is a novel approach to an old problem. As far as being able to foresee is concerned, it is as hard to foresee how you might use this as it was to foresee how you might use triodes when they were first invented, but I doubt myself if it is the kind of breakthrough the electron tube was. It is an interesting device of importance, primarily, in connection with control circuits.

Mr. FLOOD. Does it have the same relation in this field in which it is working as the relation of the transistor to the tube? Is it that significant? Is it that dramatic?

Dr. YORK. It is not that dramatic; I do not believe.

MULTIPLE WARHEADS IN ICBM'S

Mr. FLOOD. You said something to Mr. Mahon this morning about multiple warheads.

Dr. YORK. Yes.

Mr. FLOOD. In ICBM's?

Dr. YORK. Yes.

Mr. FLOOD. Is there a theory that the enemy is projecting, that when the ICBM head comes in, the ICBM will produce multiple warheads, two or more warheads?

Dr. YORK. There is not a theory that he will or is probably doing that. However, it is clear to us from the status of our own programs that that is something that could be done, provide a single ICBM with multiple warheads.

Mr. FLOOD. What would be the most important element we do not have or, if we do have it, to develop it further, to produce that desired goal?

Dr. YORK. It would be a matter of more or less straightforward development.

Mr. FLOOD. Would thrust be a condition precedent?

Dr. YORK. The bigger the thrust the easier it is to do.

Mr. FLOOD. Therefore, it is easier for the Russians than for us this morning?

Dr. YORK. It would not be too hard for us to do.

NEED FOR LARGE THRUST ENGINES

Mr. FLOOD. Do you wish to add anything to this whole problem of the disparity in thrust between the Russians and ourselves as of today and tomorrow, this question of thrust?

Dr. YORK. I do not know what I should add that I have not already said, Mr. Flood, between this session and when I was over with Mr. Gates. If you can think of something——

Mr. FLOOD. It exists. Is it important? Is it serious? Is it a great disparity?

Dr. YORK. It is at the present time a disparity of approximately a factor of 2. As far as missiles are concerned, it is not important because the payloads that we want to carry we can carry with what we have. I am talking about missiles. We can get the payload with the rockets we have. It would not be to our advantage to have a rocket twice as big because all the rest of the systems become more complicated and more expensive, all the ground handling equipment. In fact, as you know, our follow-on ICBM's are going to be smaller rather than larger.

Now, with respect to military space, all of the unmanned systems that we have in mind can also be handled, we believe, quite adequately with first stages of the size we now have. We will want to have more efficient upper stages and we are developing them. In particular, NASA is developing them.

When you come to manned space, it is another matter. There we will need larger thrust boosters, and there are two programs actively under development for providing these larger thrust boosters. Both are in NASA; one is the SATURN program, the other is the NOVA program.

Mr. FLOOD. What is the goal of that thrust?

Dr. YORK. The goal of the SATURN program is approximately a million and a half. I have to say approximately. It is eight engines and the precise size of these engines is something that will change with time.

Mr. FLOOD. What is the maximum you think the other fellow has today?

Dr. YORK. We estimate about 700,000 pounds. SATURN will be twice what he has today but SATURN comes up in the future.

Mr. FLOOD. What thrust would he have to have to send that missile 800 miles short of the Hawaiian Islands? That is where I heard the question of multiple warheads when these things come down with parachutes.

Dr. YORK. That depends on the size of the things he sends. You can do it with a missile smaller than ATLAS. The ATLAS will take its regular military payload about ——— statute miles. That is its regular military payload. If you do not put a payload on it, you can put it in orbit and it will be going forever. We did it with the SCORE project a year and a half or two years ago.

Mr. FLOOD. That is all. Thank you.

(Further information on this matter may be found in the appendix on p. 511.)

Mr. MAHON. Mr. Thomson.

MINUTEMAN PROGRAM

Mr. THOMSON. The first thing I think we should establish, Dr. York, if I heard your testimony correctly, is this. Down the road what we are interested in is the MINUTEMAN or that type of missile with solid propellant. It has mobility, concealment. As you say, it is the follow-on missile and will be smaller, not larger. You just finished saying that.

Dr. YORK. Yes.

Mr. THOMSON. That program is coming along all right?

Dr. YORK. Yes.

GROWTH POTENTIAL OF ATLAS AND TITAN MISSILES COMPARED

Mr. THOMSON. Dr. Doll, I am interested in two things. One, the advisability of upgrading TITAN against upgrading ATLAS. Then, not in your sphere of action, as I understand it, is the question of whether we upgrade either one. You have prepared a study of that, have you not?

Dr. DOLL. This would be included in the study.

Mr. THOMSON. You have presented that to General Ritland?

Dr. DOLL. Yes.

Mr. THOMSON. He is the commander of the Ballistic Missile Division and you work directly with him?

Dr. DOLL. Yes.

Mr. THOMSON. It is the agency responsible for this type of thing; is that correct?

Dr. DOLL. I think that is correct.

Mr. THOMSON. You are with Space Technological Laboratories and are vice president thereof?

Dr. DOLL. Yes.

Mr. THOMSON. You made a special study of this area of whether you upgrade——

Dr. DOLL. The total area of the growth of ATLAS, TITAN, and other large ballistic missile systems.

Mr. THOMSON. You can be helpful to me in a general sort of way. General Ritland's testimony, as I understood it, was that the ATLAS program had the same growth potential as the TITAN program. Do you agree with that?

Dr. DOLL. The question can be interpreted in a number of ways. I am a technical man. I would far rather—which I had expected that you wished—review for you the presentation which I believe you asked for in the sense that you wanted to see this report. I am not trying to dodge your question.

Mr. THOMSON. I want to cooperate with you, Dr. Doll. In your presentation I believe you prepared a chart which showed the growth potential of each as far as range is concerned, did you not?

Dr. DOLL. There is a chart which shows the range and the payload estimates for certain growth configurations of both ATLAS and TITAN. There are many possible configurations.

Mr. THOMSON. On the ultimate you can get approximately 7,000 miles with a ——— warhead with either, can you not?

Dr. DOLL. I think that is a little ambitious, but you can get a useful range with a ——— warhead out of either one, yes.

Mr. THOMSON. Are they about the same in that respect?

Dr. DOLL. They both have very nearly, in a technical sense, the same capability in the particular configurations that are covered in the report you referred to.

Mr. THOMSON. The second point that was in doubt until General Ritland came before us was the question of storability of fuels. As I understood it, both ATLAS and TITAN have about the same capability to have a noncryogenic fuel storability.

Dr. DOLL. In a technical sense I think the answer is "yes." There is always the matter of timing and programing and various other factors. Once again referring to the report, there is nothing as such stated in the particular report that you have indicated which would contradict a statement on storability.

Mr. THOMSON. With regard to flyout capability, insilo launch, do they both have that capability?

Dr. DOLL. Again from a technical standpoint, we believe it is completely feasible to develop either to have the capability of operating from a flyout silo.

Mr. THOMSON. As to the question of thrust, they would both develop about the same thrust. Is that not correct?

Dr. DOLL. You are talking of the ATLAS and the TITAN?

Mr. THOMSON. Yes.

Dr. DOLL. The thrust is developed by propulsion systems which are produced by certain engine contractors who, in turn, have certain development capabilities themselves. So it just is not appropriate in a technical sense to limit yourself to what they can do. You can get any propulsion or, I should say, any thrust you want on any one missile, depending upon the time and objectives, and so forth.

Again I cannot answer your question yes or no. We have a story which explains this, and when you see the total story, you can understand, and nobody is trying to dodge here.

Mr. THOMSON. I was quite straightened out by General Ritland's testimony, but here we have on page 11 the statement——

Dr. YORK. May I answer it, since it is my testimony?

Mr. THOMSON. No; I want to hear from Dr. Doll.

Dr. DOLL. Page 11 is not mine.

Mr. THOMSON. It is not your testimony. I will read it first:

A question that often arises in connection with the ATLAS and TITAN ICBM program is "why both"? The answer can be summed up by saying that ATLAS is available now and provides ICBM strength at the earliest possible time. TITAN, on the other hand, provides improved performance, increased sophistication, and greater growth potential.

From what you just testified, I want you to answer these questions. Then the statement continues:

It is more adaptable to the storable, or noncryogenic, fuels which should appreciably shorten its reaction time; it is also more adaptable to insilo launch * * *

From what I understood you to say, they are equally adaptable.

Dr. DOLL. I did not say they are equally adaptable. It is technically feasible to adapt either to storable propellants, more properly called noncryogenic propellants. If I said equally adaptable, I do not know where your parameter of judgment is, what is equal or better or worse. In a technical sense it is intellectually feasible to do so.

Mr. THOMSON. With either?

Dr. DOLL. With either.

Mr. THOMSON. With the same degree of success?

Dr. DOLL. I beg your pardon?

Mr. THOMSON. With the same promise of success?

Dr. DOLL. That is a subjective comment. I do not know. The matter of time, matter of program interference, matter of other technical problems are involved. I think some things you simply cannot answer "yes" or "no."

Mr. THOMSON. ATLAS is also adaptable to in-silo launch, you testified.

Dr. DOLL. As I said before, certainly you can design a system to permit ATLAS to fly out of a silo.

Mr. THOMSON. ATLAS already has the all-inertial guidance system?

Dr. DOLL. ATLAS has an all-intertial guidance system in development which has not yet been into the flight program for the control of a flight. It is not the ATLAS that has been flying during the last 6 or 8 months with the marvelous records of success. It is an advanced product, improved growth ATLAS, if you wish.

Mr. THOMSON. They flew one earlier this week?

Dr. DOLL. Open loop, without control.

Mr. THOMSON. Mr. Chairman, I do not want to transgress on the time of the other members of the committee. If the committee is satisfied here, fine. Shall I go ahead and finish out my time as far as other questions are concerned if there is anything else?

Mr. MAHON. Dr. York, I would like to have you clarify this.

Dr. YORK. I would like to comment on page 11, at least.

Mr. MAHON. Dr. Doll talked about things being technically feasible, but I have a feeling that there is something involved here other than just technical programs, money and other things.

Dr. YORK. We arrived at our present state of affairs by making changes in both of these programs as we went along. Referring particularly to page 11, in trying to be brief in a relatively long report, I may have stated things in such a way as to be misleading.

What I meant here is that the way the programs are now set up and considering the work that has been done, the TITAN is a more advanced vehicle than the ATLAS in its present concept. It is a year behind also and it has been right from the very start.

In other words, TITAN at any one time has a state of the art going into it which is generally a later state of the art than ATLAS, but it is always going to become available also later. If you compare any kind of ATLAS—and by ATLAS you mean a one and a half stage vehicle built by Convair—if you compare that with any TITAN, where by that you mean a two-stage vehicle built by Martin, it is probably generally true that you can always do with one what you can do with the other, and vice versa. But our present program, which has developed since 1954, has developed in a particular way. About 2 years ago, actually not at any particular time, but over a period of time, say roughly then, we instituted a number of changes in the ATLAS program designed to make product improvements.

About 1 year ago it became time to consider what product improvements we should introduce into the TITAN program. At that time the primary consideration was not ATLAS versus TITAN, but: What shall we do in the way of product improvement on TITAN? We chose to introduce the noncryogenic storables because we have always wanted to do that but have waited for a time when that could be done without interference with the rest of the program.

So as of today the development work necessary for the introduction of noncryogenic storables is more advanced in the case of the TITAN than the ATLAS. The extra big payload is merely a dividend and was not the purpose of the product improvement.

Mr. THOMSON. Compare that with ATLAS–E. No. 1, you just testified we do not need that additional payload in connection with the questions that the gentleman from Pennsylvania, Mr. Flood, was asking.

Dr. YORK. I did not mean to say we do not need it. That is a matter which is essentially under review. Where we stand is, that since we can get it, we are at the present time planning on having it.

Mr. THOMSON. With the accuracies you have, with the ATLAS–E, the ATLAS, with the ——— payload, you can destroy all the targets you can identify. That is what you meant when you were answering Mr. Flood's question; was it not?

Dr. YORK. I do not believe I said that we had decided we do not need the larger payload.

Mr. THOMSON. You just finished telling Mr. Flood that it was not significant militarily that we do not have greater thrust because we can deliver the payload we want to.

Dr. YORK. Yes, but that includes this ———. This vehicle we are talking about does not have bigger thrust in the context I understood you were speaking of. The TITAN–2 or the ATLAS–F do not have big thrust like the Soviet rockets and that is what we are talking about. They have slightly uprated thrust.

Mr. THOMSON. You are going to get a ——— warhead instead of about a ——— out of your upgrading either vehicle; is that right?

Dr. YORK. We could get that out of upgrading either vehicle.

Mr. THOMSON. You are going to gain by storability. You will reduce your reaction time down to approximately ———. Is that right?

Dr. YORK. That is the kind of thing we achieve.

Mr. THOMSON. With regard to exposure time with either of them, you would reduce your exposure time as opposed to your elevator launch, ——— is that correct?

Dr. YORK. That is correct, as I understand it.

Mr. THOMSON. Those are the only things we stand to gain; right?

Dr. YORK. No, sir.

Mr. THOMSON. Except for space, and you are not in the space business.

Dr. YORK. No, sir. The purpose of noncryogenic storables is to gain simplicity in rocket design. This simplicity is useful in connection with reliability primarily.

Mr. THOMSON. You make those gains in ——— if at all; is that correct? That is, if this new fuel works and everything else. In the meantime you have given up —— months in ——— of getting anything; is that correct?

Dr. YORK. No. There is a period of about—if you say ——— months, I am not sure it is not—in connection with the TITAN program there is that time. If you want more missiles in that period, if people want more missiles in that period, they can have them by buying either the earlier version of the TITAN or by buying more ATLAS. It is correct that is the way it is planned now, but that is not the fault of going to noncryogenic fuels.

EFFECT OF INTRODUCTION OF MINUTEMAN ON TITAN PROGRAM

Mr. THOMSON. When you get this, if you get it—and as yet you do not even have TITAN, now you are interjecting a new fuel, new concept, you are going to get it in ——— operational.

Dr. YORK. That is correct.

Mr. THOMSON. MINUTEMAN comes in in early 1963.

Dr. YORK. Early 1963.

Mr. THOMSON. You are getting these additional vehicles in the period in ———. Do you agree, whether it is a person like myself who thinks we have an adequate deterrent force in calendar year 1961, calendar year 1962, or some of those who say we do not have that, that that is the critical period?

Dr. YORK. That which is the critical period?

Mr. THOMSON. Calendar 1961 and 1962 before MINUTEMAN comes in.

Dr. YORK. You can make arguments that that is more critical than ———, yes, sir.

Mr. THOMSON. You can get MINUTEMAN missiles cheaper than you can get the upgraded TITAN, can you not?

Dr. YORK. That is correct, per missile.

Mr. THOMSON. They have the increased reliability and other factors which you mentioned with regard to the advantage of noncryogenic fuels?

Dr. YORK. Yes, they probably will even in ———.

Mr. THOMSON. As a matter of fact, they show on the charts presented here the other day MINUTEMAN taking off with a reliability, I think, of ——— percent and building up to ——— percent reliability very quickly.

Dr. YORK. That is true, but it will probably be true of the other also.

Mr. THOMSON. They showed it building up to ———.

Dr. YORK. These are all predictions. MINUTEMAN is an advance, the solid propellants are an advance over liquid propellants with regard to reliability and reaction in principle, yes.

FUELS USED IN SPACE PROGRAM

Mr. THOMSON. In regard to space, as mentioned previously, is it not a fact as regards thrust for space that NASA has not asked for this—National Space Administration—nor do they want this fuel you are talking about for TITAN? What is it?

Dr. YORK. The so-called noncryogenics.

Mr. THOMSON. What is the name of the fuel?

Dr. YORK. UDMH for the fuel and oxides of nitrogen for the oxidizer.

Mr. THOMSON. They have not asked for it, nor do they want it?

Dr. YORK. They have not asked for it in writing. They know we are doing it.

Mr. THOMSON. Is it not a fact they prefer hydrogen and oxygen in the CENTAUR?

Dr. YORK. For upper stages, that is correct, but that is not quite comparable.

Mr. THOMSON. That you will have in the first of calendar year 1961; is that correct?

Dr. YORK. If everything goes correctly, yes.

Mr. THOMSON. That will develop extremely large thrust that you were talking about?

Dr. YORK. It is not a matter of large thrust. It is a matter of high payload per pound of initial rocket. Those are not particularly high thrust engines. They are high efficiency engines. The hydrogen-oxygen engines, that is. However, they are not high thrust.

EFFECT OF UPGRADING TITAN ON ICBM PROCUREMENT

Mr. THOMSON. Mr. Chairman, I think that satisfies me. Whether it satisfies the other members of the committee as to the advantages of upgrading this TITAN at an expense of, as General Ritland testified, $289 million to get storability, to gain reaction time, and exposure time, not today but in ———. It would cost us $48 million to get the insilo launch capability and $179 million to get the AC spark plug all-inertial guidance system; whereas, ATLAS uses the Arna all-inertial guidance system. So at a cost of over $500 million we buy these few things and we lose missiles in ——— and shove them down the line.

Dr. YORK. This does not interfere with getting missiles. You can buy missiles in ———. The $200 million plus for the noncryogenic storables, there is an estimate to the effect——

Mr. THOMSON. Dr. York, I thoroughly agree with you. What you are doing is answering the question I was going to propound to you, that instead of doing this we could go ahead and produce ATLASES, which would do the things we wanted, build them into the program in ——— during this period we both agree was the critical period.

Dr. YORK. Let me comment on the 200-some-odd-million dollars for just the noncryogenic storables. There are also estimates that considering base installation costs, operation and maintenance, et cetera, that on the eight squadrons involved here you, very roughly speaking, get that back in a matter of some years of operation.

Mr. THOMSON. I will not debate that with you because that is covered at length in our staff report, which gives it by squadrons for ATLAS–E and TITAN.

Mr. MAHON. As I understand Mr. Thomson's question, why do you not do the best you can to expedite an availability of operational missiles during ———?

If you do that, why bother with this additional sophistication? That is the whole point. We talk about the missile lag and the danger inherent in the situation and yet we are tolerating a delay. That is the problem.

Dr. YORK. I do not think we can at this time assume that we are not going to want big liquid missiles after the MINUTEMAN arrives. There are other differences between these that are favorable to the big liquids. No one can foresee with sufficient clarity what the military situation is going to be, to be sure that you are going to be satisfied with the lower performance, higher reliability MINUTEMAN type missile.

The big liquid missile will always have a much higher yield. This now is a matter of judgment. I think it can always be built at a given state of the art to give a somewhat higher accuracy, although it needs less because of its bigger yield.

They will not be mobile. They will have to be hardened, but there we are talking about numbers sufficient so that hardening, while not as good as mobility, nevertheless, is probably effective.

Just speaking personally, I have always been rather bullish on the big missile program. This is an improvement in big missiles for use in the long run. You could trade this in and buy a few more ATLASES, but you can also buy a few more ATLASES anyway if you are a-mind to.

Mr. MAHON. In other words, if we want to avoid this delay, we can fill that up and still do this, too, if you want to spend the money.

Dr. YORK. It costs more money.

Mr. SIKES. How much money?

Dr. YORK. The way to fill that gap on that schedule—the gap is not exactly ——— months.

If you want to put ATLAS squadrons in, you can put them in at $150 million per squadron, or the Air Force is considering the possibility of adding more missiles in existing squadrons.

DECISION TO DEVELOP NONCRYOGENIC FUELS FOR ICBM'S

Mr. MAHON. Is it your position that you think we ought to get this additional sophistication, if we want to call it that, that it is impor-

tant and you believe that the liquid propellant missile has an important long-range position? You want to go ahead and improve it, therefore you insist on this program that has been presented to us; is that correct?

Dr. YORK. That is my position, but I do not know whether I insist as the word. I back it strongly.

I might comment, it is not a simple decision to arrive at and this is not a question of the ATLAS F versus TITAN II, but whether to go for noncryogenic storables in TITAN II. That was the issue we faced.

I spent considerable time on that.

Dr. Charyk, General Shriever, and personnel from the Ballistic Missiles Division, General Ritland and others, spent quite a bit of time discussing the question of whether it was indeed worthwhile to go after the noncryogenics. The proposal to put noncryogenic fuels in the ATLAS, noncryogenic propellants in the ATLAS, is a proposal that was made in the very early days of the program by the Von Neumann Committee. It was probably made internally, too.

I know it from the point of view of the Von Neumann Committee.

We did not find it possible to do this in the early stages because we did not want anything to interfere with getting necessary missiles done and that is why we waited until just barely a year ago to introduce this point. The technical people always have felt that this is a good idea for these large liquid missiles.

It did not get into ATLAS and when we were having our round of discussions on what product improvements you ought to put in ATLAS, because that was earlier in the ATLAS program than the TITAN and because the ATLAS always had this little more than a year phase advantage over the TITAN we could not put it in because we did not want to interfere with the ATLAS program at that time. It did appear sound to us.

I do not claim it as black and white but it did appear sound to us last summer when we worked this out, to go ahead now with the noncryogenics for TITAN. If there are only going to be eight more TITANS, eight squadrons of this sort, it is less clear than if there were going to be more. However, even for eight, we decided it was worth doing.

If there are going to be more, it just becomes more worth while. I do not know if there are going to be more or what, but big missiles are here to stay.

Mr. THOMSON. Last summer you say, and testimony previously was to the effect that this decision was made in November. TITAN had not flown successfully yet.

Dr. YORK. That is right.

Mr. THOMSON. It was identified more with failure than anything else.

Dr. YORK. At that time.

Mr. THOMSON. Why, since then, has there been one full range successful flight and yesterday or the day before there was another failure?

Why do you commit over half a billion dollars to upgrading a vehicle that does not work in its present state?

Dr. YORK. If you go back to where we were on the 10th ATLAS, we were not very much further ahead. In fact, it depends on how you look at the program.

We are further ahead after 10 TITANS than we were after 10 ATLASES.

Mr. THOMSON. I am not much interested in this. I cannot see the purpose of upgrading either one of them.

On this noncryogenic fuel you are considering putting in the TITAN, and you have problems as far as freeze points on that, and instead of having to cool it you have to keep it warm, up above seven or eight degrees. It has to be above.

Dr. DOLL. It does not particularly bother you insilo.

Mr. THOMSON. You have problems there. In addition to that, and as far as that is concerned, for much less money, $180 million instead of $500 million, you could have, if you wanted to get this storability capability, with kerosene and lox. You could put it into an ATLAS, the present ATLAS E missile as per Dr. Charyk's testimony?

Dr. YORK. We were not after just ATLAS storability. We have very frequently used the word "storable" where in fact we meant noncryogenic storable.

Mr. OSTERTAG. Mr. Chairman?

Mr. MAHON. Mr. Ostertag.

EFFECT OF INTRODUCTION OF MINUTEMAN ON ATLAS AND TITAN PROGRAMS

Mr. OSTERTAG. Dr. York, there is one point I do not believe is quite clear or at least enters into the picture as I see it. Aside from the TITAN versus the ATLAS in numbers or development, the point remains that the time table indicates that the MINUTEMAN is coming along, a program in which I believe you have confidence.

In this whole defense posture, we have come to recognize that mobility is an essential factor and that TITAN and ATLAS both lend themselves to firm targets. Mobility is the essential means of having an adequate and appropriate striking power and ability to defend.

In view of the MINUTEMAN coming along and its mobility and everything that goes with it, how do we justify getting into this competitive or actual development of either ATLAS or TITAN or both?

Dr. YORK. As I said earlier, and incidentally I was asked the question as to whether I was sufficiently confident to stake my reputation on this yesterday and I said yes, but that is not quite so serious as how confident I am to stake the survival of the United States on it.

I am pretty sure about MINUTEMAN but MINUTEMAN is further off so those last eight TITAN squadrons look to me like a good idea. We may very well, as we get into the 1962 budget, and so on, decide we want still more.

As I said earlier, I do not think that anyone can foresee all the possible military situations in the future so clearly you can know that these smaller—the words I used were "lower performance but higher reliability MINUTEMEN"—are going to literally replace the big rockets. There may be a place for big liquid rockets in the future along with the small ones in the same way we have several kinds of aircraft today.

Mr. MINSHALL. What is the need for a long-range liquid-fuel rocket over a MINUTEMAN as you look to the future? I do not follow that all.

Dr. YORK. It has a much bigger yield.

Mr. MINSHALL. Why do you need the larger yield?

Dr. YORK. If the only thing you are ever going to do is to fire at cities, then you do not need a bigger yield.

Mr. MINSHALL. What are we going to fire at?

Dr. YORK. I do not know. That is what I tried to say.

Mr. MINSHALL. Shooting at the moon?

Dr. YORK. No; this is for intercontinental, not interplanetary use.

Mr. MINSHALL. The only us for a higher yield weapon would be to shoot at the enemy hardened bases, but the horse will be out of the barn by then.

Dr. YORK. That sounds pretty plausible.

Mr. MINSHALL. Why go for the bigger yield weapon? Does that not sound plausible, too?

Dr. YORK. There are other kinds of hardened structures besides missile bases such as government headquarters, communications centers, and so on. We are hardening quite a few facilities besides missile bases.

Mr. THOMSON. Dr. York, we do have a liquid propellant weapon in the ATLAS and it has a proven reliability.

If I recall the testimony of General Ritland correctly, it was that if you got within ——— in the circular error probable, one would destroy one even in a 100 pounds per square inch?

Dr. YORK. No; that is not correct.

Mr. THOMSON. I want to refine that. ATLAS has been getting much better accuracy than that, approaching a ———, has it not?

Dr. YORK. It has on a number of firings, yes.

Mr. THOMSON. The circular error of probability on a 100 pounds per square inch target then would mean you would be getting ———; is that right?

Dr. YORK. Probably it is still ——— at this point, but it is a small number.

Mr. THOMSON. You have got it.

Dr. YORK. I might comment that that is with radio guidance.

We do not foresee that at the present time with all inertial. On the other hand, there will be progress and we may get back to it but more likely in these big liquid missiles than in the small, solid missiles.

Mr. THOMSON. You are questioning now, when it comes to a stake in the country's future as opposed to your reputation? You are questioning the certainty?

Dr. YORK. I would say that is more serious.

Mr. THOMSON. You are questioning the certainty of having MINUTEMAN but we will have POLARIS, then, will we not?

Dr. YORK. Sure.

Mr. THOMSON. It will have greater accuracy if we do the things that we are programed to do?

Dr. YORK. It will not have this accuracy probably. It probably will not have the accuracy of that sort.

Mr. MAHON. Just a minute. Mr. Ostertag has the witness.
Mr. WEAVER. Could I ask one question?
Mr. OSTERTAG. I yield to Mr. Weaver.

INSILO AND SILO LIFT LAUNCHING TIME

Mr. WEAVER. You mentioned you were enthusiastic about the latter six squadrons of TITAN. I understood that they are going to be of the silo-lift type. Once the enemy missiles are on the way, we are going to have them exposed up above the ground for a reaction time of 15 minutes?

Dr. YORK. No, sir.

These last eight are the insilo launch.

Mr. WEAVER. That is what we are talking about, the insilo lift type.

Dr. DOLL. Silo lift does not have that exposure time.

Dr. YORK. The insilo launch has the shorter exposure. It is the one with elevators that has the longest.

Mr. WEAVER. The gentleman stated the other day in a classified report to the committee that the last six squadrons were of the silo type with reaction time of ——— minutes.

Dr. YORK. That is why we are still in the silo. The period during which they are soft, these last eight TITANS, are the ones with the least exposure time of all of them.

Mr. WEAVER. I understood the last six squadrons were of the silo lift type.

Dr. DOLL. The last two?

Mr. WEAVER. Yes.

Dr. DOLL. No; they are the fly-out silo. That is what we were talking about.

The first six TITAN squadrons are silo lift.

Mr. WEAVER. Off the record.

(Discussion off the record.)

Dr. YORK. That is not the case of the last eight TITAN's.

Dr. DOLL. The last six TITAN squadrons are the fly-out silo, or, I mean, the last eight, with a fly-out silo which is a very short exposure time and in particular it has an inertial guidance as do the last ATLAS squadrons. The exposure time is that time during which the lid is off the hull plus the time for the missile to get to something like ———, or so, when we figure it is no longer vulnerable to attack aimed at ground stations.

Those figures run in the order of ———.

Mr. WEAVER. Thank you.

FUTURE NEED FOR SEVERAL TYPES OF ICBM'S

Mr. OSTERTAG. Before we leave this general subject of intercontinental ballistic missiles, and the program of development that Dr. York mentioned, you did not mean to leave the impression that you had serious doubts as to the progress and development and capability and operational capability of the MINUTEMAN?

Dr. YORK. No substantial doubts, but if it is not hard to be more certain, then let us do so.

In addition to the fact I do not think we are going to be satisfied to have just one type of missile; there are going to be future missile programs just like there are still airplane programs. We have quite a few airplanes under development and quite a number of these airplanes, in fact, for strategic bombardment. We have the B–70 and the possible ANP and then in the Navy, the A–3–J, which is just about done.

We also have the A–2F which is for bombardment.

I do not think we are going to have just one missile, now that we have got the MINUTEMAN, and that that has settled it for all time.

Mr. OSTERTAG. In other words, you contemplate, in looking to the future, that in addition to mobile missile operations, we will have hardened sites as well?

Dr. YORK. At least the odds are that we will have them; they are high enough so that I think we ought to proceed with making progress in liquid missilery. That is what the noncryogenic storable TITAN represents, as well as these other improvements.

COMMENDATION OF DR. YORK

Mr. OSTERTAG. Dr. York, I want to take this opportunity before I ask any further questions in regard to certain phases of your responsibilities, to pay tribute to your outstanding contribution and your leadership in this most important field of our defense. We are right proud of you in western New York.

You happen to hail from the great city of Rochester, and I believe you are a graduate of the University of Rochester. I know of no one, since I have been associated with this committee in this work, who has advanced the R. & D. program in a more effective way and no one who knew his job better. You have really made a great contribution and we are fortunate in having you as head of this most important phase of our Defense Establishment.

If I am any judge, you, as the head of the Research and Engineering Division in the Department of Defense, have probably one of the most responsible positions in our Government and our country. As I said, you are in an extremely competitive field and in a competitive area of responsibility.

SOVIET ANTI-ICBM CAPABILITIES

Now let me ask you this question: Do you have any notion that any potential enemy has any real capability in the field of antimissile missiles?

Dr. YORK. I do not know of any capability.

I do not know of any Soviet capability in this field.

They are capable of carrying out the same kind of development programs we are.

They have an able technical group, but I do not know of any progress they have made in this field specifically toward the development of an antimissile system.

FUTURE WEAPONS

Mr. OSTERTAG. For a long time, although we do not hear too much about this term of late, there was a time when not too many months ago, the ICBM or the IRMB, or just missiles generally, were regarded as the ultimate weapon.

What revolutionary changes, with possible breakthroughs, might be in the offing?

After all is said and done, have we reached the end of the line? Is this about it?

Dr. YORK. I do not believe we have reached the end of the line. The reason I do not think so is just general principles. People have thought so before and it has not been true.

With regard to delivery systems, I do not foresee another breakthrough comparable to the change from aircraft to intercontinental rockets. As I testified this morning, I think there is a potential breakthrough from the point of view of adding to military capabilities in other fields.

I am almost certain that new things are coming but I just do not know what they are.

Mr. MAHON. Inasmuch as Dr. Doll has an appointment and will have to leave shortly, are there any further questions of him?

IN-SILO LAUNCH

Mr. THOMSON. One question, Mr. Chairman.

With regard to this fly-out-of-silo launch, is it not a fact that due to acoustical problems, we cannot fully evaluate on paper, that a full scale demonstration would be required on either the ATLAS or TITAN to determine whether or not it would, in fact, work?

Dr. DOLL. I will answer yes, but I will say that characteristics of all other elements of our ballistic missiles program are covered as well. It is not unique for the fly-out silo.

Mr. THOMSON. That is all.

Mr. MAHON. Thank you very much, Doctor.

If a question arises we want a briefing on, and we realize we cannot get your full views with respect to this report without having a full briefing, then we will ask you, upon some other occasion, to appear before us.

Dr. DOLL. I will be pleased to do so.

Mr. MAHON. Mr. Ostertag?

CRITICAL YEARS

Mr. OSTERTAG. Dr. York, in the discussion here today, much has been said about the critical years immediately ahead. The timetable in development and this question of comparative strength, retaliatory power and missile numbers enter into the picture.

If we pass the so-called critical years of 1961–1962 and nothing has happened, will there be critical years immediately following that period where we will have an area of suspense, so to speak?

Dr. YORK. It depends on what the Soviets do. I was not here in the late 1940's and early 1950's but I understand that critical years used to show up quite frequently way back in those days.

It depends so much on what the Soviets do and they are so capable and have an expanding capability that I think it requires some care on our part to make sure we do not have some more critical years showing up.

Mr. OSTERTAG. We have a capability. They have a capability.

Does the critical period depend largely on their capability to strike us? Perhaps we never can prevent that.

Dr. YORK. I think the reference that most people make to these next couple of years has to do with the fact that during that period, in one particular weapons system, namely, the big intercontinental missile, they have a distinct advantage in numbers.

OBLIGATIONS AND EXPENDITURES

Mr. OSTERTAG. I would like to make a brief reference to your overall budget figure mentioned in your statement, an obligational authority request in the amount of $3.9 billion; is that correct?

Dr. YORK. That is new obligational authority under the "Research, development, testing and evaluation" heading.

Mr. OSTERTAG. By comparison, your program calls for spending $3.9 billion during fiscal year 1961 as compared with $3.7 billion for fiscal year 1960; is that exactly correct?

Dr. YORK. Yes; that spending is a prognosis.

Mr. OSTERTAG. The point is that in the field of research and engineering we are spending a little more perhaps within the next immediate period ahead than we have in the past?

Dr. YORK. Well, we are spending, or have less new obligations. In fact, less total obligations during the year which means fewer starts, but more spending which means the same or more people, more engineers, and scientists employed.

Mr. OSTERTAG. Do you have any feeling at all that this is not adequate for what is reasonably required to do this job?

Dr. YORK. What is adequate or what is not adequate depends on the judgment about the threat and the rate of change of threat, and so on, which is made by the President, the National Security Council, the Joint Chiefs, and all.

This amount of NOA money and this amount of spending is in balance with the rest of the defense program. It is for the Secretary to say whether the total defense program is right or not. This amount is in proper balance with the total program.

Mr. OSTERTAG. We are spending considerable money in the field of outer space. As I recall, the estimated figure for the budget for the Space Agency will reach a figure of somewhere around $900 million for this next year.

Dr. YORK. Yes.

Mr. OSTERTAG. Of course, they are likewise engaged in extensive research and engineering programs. They have their projects, MERCURY, SATURN, and the like and that does have a bearing, in a sense, as I see it, on rocket development; is that correct?

Dr. YORK. Very definitely.

Mr. OSTERTAG. It cannot be considered as not being applicable to some extent with, perhaps, our military money?

Dr. YORK. To a considerable extent.

You can put it this way: If there were no NASA, the Department of Defense would not be doing everything that NASA is doing, but we would find it necessary to do a very substantial part of it. The same is true if there were no Atomic Energy Commission, it would be necessary for us to do a large part of what they are now doing.

Mr. SIKES. Would you yield for a question?

Mr. OSTERTAG. Yes, I yield.

PROPER BALANCE OF RESEARCH AND DEVELOPMENT WITH OTHER PROGRAMS

Mr. SIKES. This question has to do with the proper balance of research in the budget.

What are the guidelines which determine the program balance between expenditures for research and development and the total military budget?

Dr. YORK. There are not any that you can derive in a simple fashion. However, just to give you an example, in this fiscal year, the total research and development and test and evaluation program, not only the R.D.T. & E. line items, but those things separately identified, the total of those is 40 percent as large as the total amount of procurement.

Obviously, it is procurement that you really have to relate this to, and it could be larger, but it is so large that the only money which can be considered as flexible to stack it up against is procurement money. It cuts into procurement. It could be bigger than 40 percent, but obviously it could not be an awful lot bigger.

Mr. SIKES. Is there any requirement or effort to hold research and development funds at a fixed percentage level of any other funds in the defense budget?

Dr. YORK. No; nothing definite.

There is nothing solid of that sort, but just that in all levels of defense and within the services, when the budgets are being made up, it is inevitable that the procurement people and the development people will end up arguing with each other about what is more important.

Mr. SIKES. Thank you.

Mr. OSTERTAG. Dr. York, in that connection, it is reasonable to say, is it not, that with the effort and money and application of engineering and research with regard to atomic energy and space and defense generally, when you package it all together, it does have a terrific potential in the field of development by this country?

Dr. YORK. It is a very large program, Mr. Ostertag.

RELATION OF MILITARY AND SPACE PROGRAMS

Mr. OSTERTAG. Is there any conflict between our military and space efforts? By that I mean, in the development and objectives and organization?

Dr. YORK. I do not think there is any conflict, any fundamental or important conflict. There is always a certain amount of competition as distinct from conflict, but nothing that is undesirable or serious or unhealthy.

Mr. OSTERTAG. Dr. York, there is a reasonable amount of cooperation, is there not, between the two?

Dr. YORK. There are very good relationships at the present time.

Mr. OSTERTAG. There has been some feeling and many people have harbored the notion that we are running into a head-on collision between the Space Agency attempting to explore outer space and their dealing with space matters, and then our missile and other weapons which would have a relationship to outer space. Actually, and as a matter of fact, some of your ATLAS and other missiles have been used in connection with many of their tests, and their projects; is that correct?

Dr. YORK. Yes, that is particularly true of the THOR and JUPITER.

Mr. OSTERTAG. As things move along, is it reasonable to assume that where there is a military aspect that there will be no conflict as compared with the objectives or purposes of the other agencies?

Dr. YORK. There is a potential for conflict, and so I cannot guarantee that there will not be any, but if the people who are involved in the future are as willing to get along with each other as the people who are involved now, there will not be one.

There will be arguments and discussions as there are between such groups.

DECOYS

Mr. OSTERTAG. Speaking of missiles, we have a decoy known as the QUAIL, which will be used in connection with bombers.

As I recall it, you pointed out that insofar as the possible use and effectiveness of the NIKE-ZEUS, the real problem is that involving decoys for missiles; is that correct?

Dr. YORK. That is the most serious technical problem associated with ZEUS.

Mr. OSTERTAG. Have we any development in being which would likewise provide decoys for missiles?

Dr. YORK. Yes; there are studies of decoys going on both in our offensive developments our missile people are developing decoys, and in connection with the ZEUS and DEFENDER programs, there are other studies and developments of decoys.

Mr. OSTERTAG. Does the picture look like you are going to be successful in that field?

Dr. YORK. Yes, but that is largely from theoretical grounds or simulation work done on the ground.

There is insufficient data and virtually no data from an observation of these things under full environmental conditions.

DEVELOPMENT OF POLARIS ON SURFACE SHIPS

Mr. OSTERTAG. This next question I have perhaps is one of military decision or responsibility, but in connection with the POLARIS, it has struck me, that the POLARIS missile might well be employed, or be deployed, on surface ships.

What is your feeling on that? Do you think that that is a practical type of program?

Dr. YORK. Those are two different things. It is practical. At least, I am sure it is practical.

In fact, as you know, part of the test program involves POLARIS on ships. The Navy has made thorough studies of the problem and

has drawn up possibilities of how these could be put on various kinds of ships, guided missile cruisers, regular cruisers, victory ships, and things of that sort.

From a technical point of view, there are no problems. I mean that there is no serious problem if the operational people decide they want to do that and there is nothing standing in their way.

On the other hand, as I understand it, and really this information would be much more appropriately obtained from the Navy——

Mr. OSTERTAG. I realize that.

Dr. YORK. You cannot get these really sooner than you could get more submarines and for a number of reasons you cannot get them much cheaper either. It just has to do with considering the actual facts. What ships have you got? What would you have to do with them? What state are they in? What do you have to do with them to keep them in service?

It is somewhat cheaper, but it is not a large factor cheaper to do that nor is it something that can be done at this time more quickly. A couple of years ago you could have, if you decided to do it, done it sooner. But by "sooner" I do not mean that it might not be 3 or 4 months, but I do mean that we are not talking about moving the program up by years or moving it into 1961 or early 1962 or anything like that.

ANTISUBMARINE WARFARE

Mr. OSTERTAG. This point has been covered in your statement when you referred to undersurface warfare or antisubmarine warfare. This committee has, as you well know, been greatly concerned with that phase of our defense and whether or not we are doing all that is necessary and possible.

Would you say offhand that we are going to the extreme in dealing with this research and development and engineeringwise?

Dr. YORK. We are not doing all that is possible in any narrow field; you can always do a little more. It is the Navy's view and I have discussed this with them and others in my Office have discussed it with them, at considerable length, that the Navy's ASW RDTE program is in proper balance with the rest of the Navy's research and development.

They regard it as a very high priority program but that, in turn, does not mean every possible ASW program is therefore a higher priority than any other ASW program.

Mr. OSTERTAG. Where does that stand in connection with your program of overall research and engineering?

Dr. YORK. We give that high priority. I believe that we are asking for $180-some-odd million in connection with research and development. The $45 million which you added on last year, and for which we have made the arrangements, my Office working with the Navy has made the arrangements to use that money, and most of that will, in fact, be spent next year.

It is being obligated rather late in the year so that, in terms of spending, next year's ASW program is substantially up.

In terms of obligations, it is the other way around. In terms of spending, it is substantially up next year.

DISTRIBUTION OF BASIC RESEARCH PROGRAMS

Mr. OSTERTAG. In your statement on page 6, you refer to the basic research and studies. You point out that approximately 72 percent of the program is accomplished by contracts with industrial organizations, 7 percent by educational and other nonprofit institutions, and 21 percent by Federal Government installations.

Is that the percentage with regard to basic research?

Dr. YORK. No. That is of the R.D.T. & E. type.

Mr. OSTERTAG. What is the picture with regard to basic research insofar as our Defense Establishment is concerned?

Dr. YORK. I believe the distribution of figures on basic research would be very different. Basic research is predominantly performed in universities and nonprofit institutions. It comes under the category of only 7 percent, and that would be the largest category in basic research. A considerable amount is in our Federal Government installations, but frequently for the reason that administratively it is especially difficult, it is not always separately identified.

It is a part of the regular going program of these laboratories. Then there are some basic research projects carried out by industrial organizations. The predominant distribution, the receivers of basic research funds, are educational and nonprofit institutions primarily.

Mr. OSTERTAG. Do you have any way of breaking that down?

How many institutions and students are involved?

Dr. YORK. Yes; we do that. We could do that. I do not know if we have it readily available, but let me say it is a very large number of students and institutions because there is about $120 million in this field and more than half of that goes to the universities.

Most of that is in very small contracts. These are the ONR contracts that run $20,000, $40,000, $60,000 or $100,000.

Mr. OSTERTAG. That is all.

Thank you, Dr. York.

Mr. MAHON. Mr. Lipscomb?

Mr. Lipscomb has no questions at this time and I yield to Mr. Weaver.

CONFLICTS WITH SERVICES

Mr. WEAVER. Doctor York, I certainly have a great deal of respect for the contributions that you and others of your agency make in our defense effort.

I am wondering how independent your agency is as to the plans and things you develop from scratch and the pressure put on you by the services for wanting this and that? In other words, if you have an idea and the Air Force wants it, and you may have several ideas, what would you do?

Could you comment on that?

Dr. YORK. I do not quite understand your question.

Perhaps it may be based on some misunderstanding.

Mr. WEAVER. How far do you folks go without being pressured by this service or that? I notice the whole theme of your statement today seems to support everything, for example, that the Air Force advocates.

Dr. YORK. I do not think so. If that is true, it is because the Air Force and I got together before we came up here and reached an agreement. That does not mean that it started out that way.

That is how it ended up.

Mr. WEAVER. When do you differ with them?

Dr. YORK. That is how it ought to be.

Mr. WEAVER. When?

Dr. YORK. For example, the biggest difference on the record was last summer with respect to aircraft nuclear propulsion. There are a great many points which you can say we differ on. We differ in discussions where what we are trying to do is to seek the right answer, and we generally manage to come up with things where we agree. The same thing applies to the Army and the Navy. The glaring exception is NIKE-ZEUS but, there again, these are not agreements necessarily always in advance, but agreements after considerable discussion.

I do not regard this as pressure.

My Office works with the Air Force, Navy, and when they argue with me, I do not regard it as pressure.

Mr. WEAVER. I would say you are not completely independent then of the services after you develop something?

Dr. YORK. I am a part of the Department of Defense and so are they.

Mr. MAHON. Would the gentleman yield?

Mr. WEAVER. Yes.

REVIEW OF PROGRAMS

Mr. MAHON. I think Mr. Weaver is undertaking, among other things, to discover whether or not your Office brings to bear fresh and independent judgment on these decisions which are made in the Pentagon.

Dr. YORK. Yes.

There is an enormous number of programs and we do not go over all 15,000 of these tasks each year with an eye to satisfying ourselves that everything is right. A great deal of what is done in the Department of Defense, a great many of our approvals, are based on the fact that we know the people who are asking for the approval and they sound reasonable in this case.

Mr. MAHON. Do you have sufficient staff and sufficiently qualified people to really do the job of taking this second look?

Dr. YORK. Yes.

If it is a question of how many cases you want to apply this to, I have a little over 100 technical people of varying ability. When something important comes up, I do believe that we are capable of giving it a very good and independent look.

We have not only the people on the staff but we have a large number of scientific and technical and engineering advisers.

Furthermore, I have a very close personal working relationship with Dr. Kiastiakowsky and I know what his people are thinking. I talk most of these things over with them on occasion and we appoint joint committees between myself and the President's Science Advisory Committee to look at things.

These committees consist of very good people. The people are variable but many of these committees consist of very good people.

Mr. MINSHALL. May I ask a question?

Dr. YORK. Am I getting at your point?

Mr. WEAVER. Yes.

Mr. MINSHALL. The Air Force and Navy come up with a particular problem and it is their project. They are for that project.

Dr. YORK. Yes.

SOURCES OF VIEWS IN OPPOSITION TO PROJECTS

Mr. MINSHALL. Who presents the opposite side of it?

Dr. YORK. If we have our doubts about it, we will scrounge——

Mr. MINSHALL. Who is going to put a doubt in your mind unless somebody from the outside puts it there?

Dr. YORK. Sometimes people on the outside do. We get volunteer information from the outside.

Mr. MINSHALL. Do you rely on the volunteer information?

Dr. YORK. From the other services.

Mr. WEAVER. Would you name a few of the other sources?

Dr. YORK. Yes. Members of Dr. Kiastiakowsky's Advisory Committee, with which I say I am in rapport. They are very willing to criticize what we are doing and we—meaning me, or the services in the Department of Defense—likewise I personally know and so do many of the members of my staff, members of the Air Force Science Advisory Board, the Navy Research Advisory Committee, the Army Scientific Advisory Panel.

We meet these people formally, informally, officially, unofficially, and they are pretty free with advice with regard to what they think is going wrong both in the service for which they are an adviser and they are frequently frustrated advisers, as you can imagine, within one or the other departments.

I do not know how you would organize an opposition, a group whose job it is to come up with opposition to ideas, but we get plenty of unorganized advice.

I think it is very good.

Incidentally, Mr. Huff reminds me that there are trade associations. There are official societies, engineering societies, scientific societies, and the National Academy of Sciences, and the National Research Council, which is another independent, but organized group, that is free with its advice, especially if you ask them; and we do.

Mr. FLOOD. And this subcommittee.

Dr. YORK. And this subcommittee; that is quite correct.

Mr. WEAVER. What about the conflicts that arise between the services on various projects?

Dr. YORK. That sometimes is a source of negative advice, although I do not exploit it, but it does happen.

AREA DEFENDED BY NIKE-ZEUS FOR $15 BILLION

Mr. WEAVER. Dr. York, on page 15 where you refer to the NIKE-ZEUS, you say that the effective radius that could be defended by a NIKE-ZEUS battery would be relatively small and this would mean,

for even a program to defend only a part of the United States, a tremendous investment of $15 billion which would be required.

How much of an area are you talking about there?

Dr. YORK. $15 billion, and this can be argued with, but I think a good estimate would be that $15 billion worth of ZEUS would protect that area occupied by about 40 percent of the population.

BOMARC PROGRAM

Mr. WEAVER. In view of the statement you have made, and I do not want to get into a matter that the gentleman from Ohio always discusses, but I do not understand how you can say that when, for example, we have spent a tremendous amount on BOMARC and so to speak have nothing.

Dr. YORK. We have not spent this much.

Mr. WEAVER. I wonder if you could comment on that, too?

Dr. YORK. We do not have anything here, too. We have more BOMARC than we have ZEUS, Mr. Weaver.

Mr. MINSHALL. The score is tied zero to zero, for the sake of the record.

Dr. YORK. We have BOMARC A and we do not have Zeus I.

Mr. FLOOD. BOMARC A to do what?

Dr. YORK. For interception of aircraft.

Mr. FLOOD. Aircraft?

Dr. YORK. That is what it is designed for, Mr. Flood.

Mr. WEAVER. I mentioned BOMARC because you said on page 13 that our defense system against attack by manned bombers is largely completed.

Are you assuming that BOMARC will never succeed?

Dr. YORK. I am referring to development and that largely means most of the things that have been developed, or most of the development programs, for bomber interception which are behind us. That is all.

"Largely" is a bad choice of words, but the majority of the development in that field is behind us. I do not mean by that things are finished, but I do mean that stage 1 development is essentially done. That might include HERCULES development which is virtually done and on BOMARC A the development is essentially done.

Mr. WEAVER. If it does not work, you still must try for a finished product that works. That is all——

Mr. MINSHALL. It is essentially done because you do not feel you need any more; is that correct?

Dr. YORK. In the BOMARC——

Mr. MINSHALL. You are not developing right now any new missiles, or antiaircraft missiles, are you?

Dr. YORK. BOMARC B.

Mr. MINSHALL. That is the only one?

Dr. YORK. We are also thinking about—that is the only missile; that is the only ground-to-air missile. We are looking into the possibility of developing an improved air-to-air missile for improved aircraft interception capability.

NEED FOR NIKE-ZEUS

Mr. WEAVER. Going back to the NIKE-ZEUS, even with the expenditure of $15 billion, don't you think about any amount would be justified if it would protect our people?

That is why I want your comments in view of the amount of money we have expended so far on BOMARC where we have nothing.

Dr. YORK. It is hard for me to argue about ZEUS on the basis of what we have done on BOMARC. As to whether we are justified in spending $15 billion or $80 billion for the protection of the people——

Mr. WEAVER. What are we spending all of this money for, then?

Dr. YORK. It is not for me to say it is justified to spend a large amount of money or not. However, I am involved in the question, given a certain amount of money as to what is the right way to spend that.

As I testified this morning, there are competitive methods for doing what NIKE-ZEUS is supposed to do, at least in general scope, if not in detail.

If you want to protect people there are fallout shelters which look like a very good competitor for ZEUS for the sole purpose of saving lives.

On an investment basis, if you want to protect your deterrent mobility and hardening, it looks like competitive systems with ZEUS.

Then there is the bigger question of whether ZEUS would work, or whether you get anything for this $15 billion.

Also if you want to save lives, there is the competition between a defense system and a deterrent, because a deterrent, at least, has a chance of working 100 percent.

It either works 100 percent or not at all, whereas these things, these active defenses, are, at best, partial.

Mr. WEAVER. What discouragement, if any, have you received from any of the services or the Joint Chiefs of Staff in regard to NIKE-ZEUS continuing?

Dr. YORK. I have not received any discouragement from them but let me hasten to add——

Mr. WEAVER. Have they discouraged you and your associates from normally proceeding with something that you ordinarily would proceed on?

Dr. YORK. Let me put that in the right context. The Secretary of Defense asked the Joint Chiefs for their opinion on NIKE-ZEUS. They have recommended to the Secretary of Defense that we not go into production but that the research and development program be continued. That is the only military advice that I have gotten except that which has been given to the Secretary.

We all work for the Secretary.

Within the Army, the advice is the other way around, as I am sure the Army will testify. There is no one else coming around and trying to get us to stop. On occasion, there may be a caustic remark dropped in some circles, but it does not constitute pressure.

X–15 PROGRAM

Mr. WEAVER. Will you summarize briefly the progress of the X–15 and what any recent flight tests have disclosed?

Dr. YORK. I am not really well up to date on that.

Mr. WEAVER. In a technical way

Dr. YORK. I could submit something for the record?

As you probably know, that program is quite a bit behind schedule and there have been all sorts of troubles with all sorts of details with the system.

Mr. MAHON. We can ask the Air Force to give us the details on that.

Dr. YORK. The Air Force can give you a good discussion on that.

They have not reached their objectives of mach 6 and of these very high altitudes which they must reach in order to be said to be getting the results they were after.

DYNASOAR PROGRAM

Mr. WEAVER. Do you know about how much we have spent on DYNASOAR?

Dr. YORK. On the DYNASOAR program actually to date, really very little. I do not know, but I suppose it might be——

Mr. MAHON. We can go into that in detail with the Air Force.

Dr. YORK. So far, actual expenditures are in the few million category. On the other hand, we are asking for about $60 million, something like that, for next year.

Mr. WEAVER. After the perfection of the DYNASOAR, what do you think we will accomplish with that to compensate us for the great cost involved?

Dr. YORK. The DYNASOAR program has been used to describe a whole continuing change of designs and events. The first phases of the DYNASOAR program are a research program and the problems of controlled flight up to mach 25 and up to a few hundred thousand feet, which are the reentry conditions.

This will be an expensive program. What we will be learning is how to achieve controlled flight, what are the problems and what is the technology of controlled flight at these extremely high altitudes and velocities.

What is the value of that? The value of that depends on where the space program is going and where high-speed aircraft, controlled aircraft, are going. We do not really quite know where those are going.

On the other hand, as a matter of faith, we are sure that we are going to need someday controlled flight at those altitudes and velocities and the purpose of the DYNASOAR program is to yield that information.

It will be very expensive.

BOMB ALARM SYSTEM

Mr. WEAVER. Could you tell me what you and others of your organization have had to do with this bomb alarm system?

Dr. YORK. Bomb alarm system?

Mr. WEAVER. Yes.

Dr. YORK. What we had to do with it was that about a year ago we pressed the Air Force to get on with the installation of that equipment. They had already been thinking about it basically, but what we did was to let them know we thought it was a pretty good idea and would like to see it accelerated.

They have accelerated it. It is due to come into at least partial operation shortly and full operation after that.

By full operation, I mean about 100 key targets in this country hooked together with telephone to half a dozen or so key decision-making points, such as North American Air Defense Command, the Strategic Air Command, and so on.

That is really part of the ballistic missile early warning system in that it is designed to take advantage of any possible dispersion that we get in a Soviet salvo.

It is rather expensive, but it can be of great potential use.

PERFORMANCE OF IMPROVED TITAN

Mr. WEAVER. On page 11 you mention the TITAN ICBM and some of its characteristics. You say it provides improved performance and increased sophistication and greater growth potential. Then after that you list a number of desirable features that this ICBM has.

Would you tell me what you mean specifically when you say "improved performance"? Tell me specifically what you mean by "increased sophistication."

Dr. YORK. As in the earlier discussion, I wam not comparing all possible TITANS with all possible ATLASES, but only with the most advanced TITAN now planned and the most advanced ATLAS now planned, not any possible ATLAS with any possible TITAN.

Taking the most advanced TITAN now planned, which is the TITAN to be used in the last eight squadrons, and the most advanced ATLAS now planned, which is the ATLAS to be used in the last six ATLAS squadrons, the differences have to do with the fact that the noncryogenic storables lead to greater simplicity and higher reliability, we believe.

Mr. WEAVER. You are referring just to performance?

Dr. YORK. Yes. In terms of range, payload, and accuracy there is no important difference. It does happen that the TITAN for those last eight has a bigger payload than the more advanced ATLAS, but it is almost accidental. It does not have to be that way. The other one could be changed, too, as I testified before. It comes in things like the simplicity that we believe will be achieved through use of noncryogenic storables. This all-inertial guidance system should be better than the one in the ATLAS.

The in-silo launch should be both simpler and with smaller exposure, simpler because it requires fewer moving parts, does not require an elevator but has to work after an attack.

Mr. WEAVER. That is all I have, Mr. Chairman.

Mr. MAHON. We shall resume tomorrow at 10.

FRIDAY, MARCH 11, 1960.

Mr. MAHON. We shall resume our hearing this morning with you, Dr. York.

Mr. Minshall, who has actively participated in the hearings, I am sure has some questions to ask at this time.

Mr. Minshall, will you proceed?

BOMARC FAILURES

Mr. MINSHALL. Dr. York, as I stated previously in my off-the-record remarks, it was not my intention to bring up anything concerning BOMARC at this time because it is the understanding of the committee that we are going to have a special briefing on the BOMARC and discuss it at that meeting the latter part of this month.

My good friend, Mr. Sikes, injected the BOMARC into the current hearings, so I feel it is incumbent upon me at least to get your views and have you clarify them more than they have been clarified for the sake of this particular record.

In your statement on page 13 you said:

> BOMARC B, with an effective range of about twice that of the BOMARC A model also provides a means of making bomber interceptions farther out from our own borders. The recent series of flight-test failures on the BOMARC B was caused by difficulties in a fuel-metering valve in the sustained ramjet engine. This defect has now been corrected. While the last BOMARC B test was not completely successful, the difficulty was one involving guidance and not the "fix" on the faulty valve.

As an aside to those remarks, you also interjected, or said, that "those remarks were written"—and I quote you verbatim as nearly as I can—"before BOMARC had been doing what it is now doing."

I wish you would amplify those remarks and make them a little bit clearer.

Dr. YORK. I am not sure I understood the rereading myself.

Mr. MINSHALL. I wrote it down at the time you said it, and I am sure the record will substantiate it. That was the thought you gave out.

Dr. YORK. Well, to go back, the statement was written and not ready prior to the BOMARC test of March 5. The BOMARC test of March 5 was another failure, and that one, as I understand it, was caused primarily because of errors involving its instrumentation which occurred in the blockhouse and which caused the launching sequence to proceed incorrectly and the ramjet flares ignited too soon.

In fact, well before launch, or the launch attempt, I should say. The record is as you have said—that the BOMARC B has had a series of, I now believe, seven successive failures.

As with all development programs, it is not clear what this means for the future. For example, it does not at this point even necessarily mean that the schedules originally laid down cannot be met. It obviously throws doubt on those, but it does not necessarily mean that they cannot be met at this point.

I was going to go on with regard to other remarks in the statement but perhaps I had better wait.

Mr. MINSHALL. What is your future testing program for BOMARC B?

Dr. YORK. I do not know precisely what the plans are or when the next test is.

Mr. MINSHALL. What concerns me, and what concerns many members of this committee with the exception of my good friend, Mr. Sikes, is the successive series of failures during the 8 years since 1952 that this program has been underway, I believe, and we will have spent close to $4 billion on it if we keep up with the program.

Dr. YORK. By the time it is finished.

Mr. MINSHALL. What concerns me most is that by the time we have it in the inventory it will be obsolete and as you implied yesterday, you are not researching and developing any more antiaircraft defenses. Yet that is exactly what you are still doing with BOMARC B.

Dr. YORK. We are still in the development program on BOMARC B; yes.

As I also mentioned yesterday, General Shriever has set up a special review committee to investigate this accident.

Mr. MINSHALL. When did he set up that committee?

Dr. YORK. When?

Mr. MINSHALL. Yes.

Dr. YORK. Recently, but I do not know——

Mr. MINSHALL. You mean just recently after all these years?

Dr. YORK. This is a special review committee.

OBSOLESCENCE OF BOMARC

Mr. MINSHALL. That is the trouble with this whole program, they always come up and say this can be corrected. If it is a failure in the ramjet process, a failure in the metering device, a failure in the pump, they say it can be corrected. It has been a series of failures and when you hear criticism from such people as General Medaris and General Taylor and Admiral Burke and Admiral Hayward and General Trudeau and even General White, himself, of the Air Force, who said that there has been considerable slippage in the program, as he put it, what are we to think? We did not carry it out much further with him, but we are beginning to wonder whether or not we should put any more money into BOMARC when it is going to be really obsolescent and outmoded before it can ever become operational.

Do you not honestly feel that?

Dr. YORK. As I said yesterday, this is a question which is under review in the Department of Defense and I am involved in the review. The possibility that BOMARC may be oblescent or obsolete before it comes in, is not, in fact, necessarily related to these test failures, although it is obviously connected.

More nearly related, or more closely related, is the overall question of what will be the bomber threat at the time this would be available. How long will it last and so on?

WEAKNESSES OF BOMARC B

Mr. MINSHALL. What is your honest appraisal of it? Do you think we should keep on with this program and put it in the inventory when we know the missile threat is going to begin to come in very much in evidence in 1961? This is not going to be in the inventory even if it

were successful tomorrow. It could not be in the inventory before 1963.

Dr. YORK. That is correct for BOMARC B.

Mr. MINSHALL. The BOMARC A is actually ineffective against any supersonic aircraft. You have only a couple of those down in Suffolk and the range of that is limited seaward to low-flying aircraft, 20 miles because of the SAGE computing system?

Dr. YORK. That is correct for low-flying aircraft.

Mr. MINSHALL. This is not a controversy as far as I am concerned between BOMARC and NIKE-HERCULES. I think that is a smokescreen that the Air Force tried to throw up. It has not been that as far as I am concerned. I am only concerned because I do not feel that the BOMARC program has been a workable one or will be workable in time to be of any use to the defense of our country.

Dr. YORK. In 1963, certainly, the main threat will be from missiles. On the other hand, there will continue to be an air threat as long as the Soviets maintain a long-range air force, such as they now have. In order to be able to give an answer with complete assurance one way or the other, one would have to know what the Soviet intents are for 1963, 1964, 1965, and 1966 with respect to their air force. That is, in order to give that with complete assurance. Everybody can put his own judgment against this question and that is what we are trying to do in the Department of Defense now.

Mr. MINSHALL. You do not have any doubt about the judgment of the admirals and generals whose names I previously mentioned; do you?

Dr. YORK. No. I am sure this is what they had in mind, that missiles will be the principal threat in those days, but that is not necessarily the same as saying, "Let us not have any antibomber defense." We are going to require some antibomber defense as long as there is a Soviet long-range air force. The fact that it may not be as critical as an antimissile defense does not mean that it is not of some importance.

As I say, we are discussing that in the Department and I do not want to prejudge it. This is really an operational and deployment problem, or largely an operational, deployment problem, and I just would not want to prejudge what the Chiefs are trying to come up with.

Mr. MINSHALL. From a research and development program point of view, and that is your primary field, have you had any other programs that have had a history of failures for so many years, since 1952, and into which they are still sinking billions of dollars? If so, name them.

Dr. YORK. I cannot think of any offhand, Mr. Minshall.

Mr. MINSHALL. In other words, this one stands out by itself?

BOMARC A PROBLEMS IN TESTING

Dr. YORK. I am not familiar with the program beyond a couple of years. During that time the BOMARC B has done poorly, indeed. The BOMARC A, however, had come to the point where it was working, although, as you probably know, the BOMARC A has not done well either in the last year.

Mr. MINSHALL. What do you mean, it has not done well?

Dr. YORK. There have been some test firings of it and it has not performed properly either.

Mr. MINSHALL. We do not have a BOMARC A or B that works and the public relations on this is all out of proportion. I have clippings from newspapers from all over the country implying that BOMARC is now defending us against enemy air attack.

Dr. YORK. The troubles with BOMARC A and B have been traced back largely to ground equipment. That program was going well when it was at Canaveral and then they moved it over to Eglin. The ground equipment was evidently installed incorrectly and following that move, it was not compatible with certain minor changes that were made. It shows poor work but it does not show the BOMARC A will not work.

Mr. MINSHALL. Isn't it true that BOMARC B has no missile defense capability whatsoever?

Dr. YORK. That is correct.

Mr. MINSHALL. To date, BOMARC A and BOMARC B are not even a defense against enemy aircraft; is that correct?

Dr. YORK. BOMARC A, where it is installed, is probably a defense against aircraft.

Mr. MINSHALL. How much of a defense?

Dr. YORK. I do not know.

Mr. MINSHALL. You do not think it is a very good defense, do you? You just made a statement indicating that BOMARC A had not been too successful.

Dr. YORK. BOMARC A in tests recently at Eglin has not been successful. BOMARC A can be said to work. These tests at Eglin were not successful due to——

Mr. SIKES. May I ask a question off the record at this point?

(Discussion off the record.)

Dr. YORK. I do not have any good, solid information later than the end of January, but I was discussing this program yesterday with the people who know something about it and I got the impression, which I can check, that there was no record of success since then. I am not sure of that, and as I stated to both of you, I am certain the BOMARC A and B can be made to work despite this record.

Mr. MINSHALL. When?

Dr. YORK. No one can predict the future.

Mr. MINSHALL. You cannot predict at all, can you?

Dr. YORK. No; but so far the situation is such that there is not necessarily any slippage in the program, and there is cause for a certain amount of pessimism, to be sure.

Mr. MINSHALL. In other words, the program calls for this to be in the inventory, if everything went along as of a year ago, in 1963, and now they cannot get it possibly before 1964?

Dr. YORK. I think that the Air Force does not agree with that as a flat statement.

Mr. MINSHALL. What do they agree with? They do not agree with anything.

Dr. YORK. They still can get it in 1963.

Mr. FLOOD. Will the gentleman yield?

Mr. MINSHALL. Yes.

Mr. FLOOD. For a scientist you have always impressed me, not only as a scientist, but for an extraordinary facility and glibness for one of the long-haired boys. I never quite met a scientist like you.

Not necessarily slippage. That is the kind of language I use, but to have it come from you is something else. You are developing a technique peculiar to our technical witnesses.

The fact remains that we have been, and are continuing to experience slippage, as the term is customarily used at these hearings. Do you agree with that?

Dr. YORK. That may be.

Mr. FLOOD. Doctor, that is so as a fact, is it not?

Dr. YORK. There has been slippage in the test program.

I understood the important question to be, Is there slippage in the predicted deployment?

Mr. FLOOD. That is not the question I am asking you. While I do not put words in the mouths of witnesses——

Dr. YORK. That kind of slippage is important.

Mr. FLOOD. I will state the premise so that there will be no question about what I mean. I think my friend will hasten to join me.

Will you go back and repeat the question I asked just a minute ago with reference to slippage?

(The question was read by the reporter.)

Mr. FLOOD. We have been, and are continuing, to experience slippage as the program progresses. I am not talking about the target date and I am not talking about the possibility, or even probability, that the original target date may be achieved. The fact remains, and I repeat this for the purpose of emphasis since this is apparently necessary, we have been and are continuing to experience slippage, period.

Dr. YORK. Yes, sir; slippage in the development program.

Mr. FLOOD. You see how I have to torture this out of you.

I suppose you want me to go ahead now?

Mr. SIKES. Would you yield to me?

Mr. MINSHALL. Yes, Mr. Sikes.

Mr. SIKES. I want to assure my good friend that I am not unconcerned, as he implied a little bit earlier, about the success or lack of success of this program. I am very seriously concerned and if this program is no good it should be washed out. We should not be throwing good money after bad if this weapon is not going to do what it is designed for. I think it is going to be helpful, Mr. Chairman, to this committee if we ask for a complete record of firings, to show the successes and the failures of BOMARC from the time it first entered its test period and some comparison with other weapons of the newer type with which there also have been difficulties in the early stages.

Let us see what the actual story is.

My information is that BOMARC A has been doing quite well and apparently that does not coincide with the information Dr. York has. I would like for us to get an actual record of firings.

Mr. OSTERTAG. Would you not want a complete evaluation?

EVALUATION OF BOMARC

Mr. SIKES. We are presumably going to have, within a short time, an evaluation by the Air Force on this matter. They are now making a new study, following a series of disappointing failures in BOMARC B. I agree with the things that have been said about the comparative lack of effectiveness of BOMARC A, against modern targets, even if BOMARC A is now working satisfactorily.

Mr. MINSHALL. For the record, I think it should be pointed out at this time that the BOMARC A, what we have of it, is a couple of birds down at Suffolk whose range is limited to 25 miles seaward. They also have a couple of birds up at McGuire.

Mr. SIKES. I just finished saying if BOMARC A were operational and in place today, it would not be the weapon that we need for the period which we are entering. We do need BOMARC B. If BOMARC B is not going to function and function properly, we need to know it.

I think we should, at least, have all of the facts that are going to be available as a result of the present reevaluation before we judge it. The story has not been a good one and it has been disappointing. ATLAS was also disappointing a few months ago, very disappointing, yet I note this morning we had the first failure in 23 tries. ATLAS is now coming along very well. BOMARC B may also.

Mr. MINSHALL. That was a baby compared to this program.

Mr. SIKES. BOMARC B may come along very well once it gets over the hump. I am not unconcerned about this. I am very much concerned about it and I do not think we should spend money on any program unless it is a good one.

Mr. MAHON. Let us evaluate this discussion. We will have a special hearing and there are new recommendations coming up and it seems to me we have probably gone as far as we should with Dr. York at this time on this issue.

Mr. MINSHALL. The only other thing I would like to do is to reply to Mr. Sikes that they have seen these official reports, each one of them, on these test failures. It is a constant "hasta manana." They say, "We failed but we are going to do all right the next time."

This has been going on to the tune of $4 billion since 1952.

Mr. MAHON. I think this is something that we will get more to the meat of when we have the special hearing. Perhaps Dr. York can add something else, and, if so, he can do so now.

Dr. YORK. I would like to make a comment rather than an addition.

My comment, in answering this question, is the same as your problem. I am also waiting for more information from various sources on this program.

Mr. MINSHALL. That is what the whole thing is about. We have been waiting for information on this program since 1952. It is always "hasta manana."

Mr. FORD. I do not think it is fair, Mr. Minshall, to expect him, with the multitude of programs, to have on the tip of his tongue the latest information. We ought to have the so-called experts in BOMARC appear and when they get through their presentation, if they cannot justify it, then the committee can act as it sees fit.

Mr. MINSHALL. The only reason I brought it up was that Mr. Sikes brought up BOMARC yesterday. I had not planned to touch on it at all.

Mr. MAHON. I think it is all right up to this point, but with respect to further interrogation, I think it would be well to wait until later this month when we have the special hearing.

Mr. MINSHALL. I will abide by the advice and suggestion of the chairman.

Mr. FLOOD. With this one addition, since Mr. Sikes wants a detailed presentation, I quite agree with that and the time period he suggested on these items. For the people who read this record, we also want them to supply us with details on the targets at which they are firing; the kind and nature.

Mr. MAHON. We will do all of that when we have the special hearing.

Mr. OSTERTAG. I believe Dr. York wanted to make an additional comment.

Dr. YORK. That was my only comment. My difficulty with this question is that I am also right in the middle of trying to get the same kind of information you are. I have not got it and I wanted to avoid prejudging the question.

Mr. MAHON. We have the special hearing set up for the 29th.

Mr. MINSHALL. I admire and respect Dr. York in this field, and his ability is far beyond any capability I should hope to have on this subject. However, I have had access to some of the facts and it certainly has not been Dr. York's intention to hoodwink or bamboozle the committee at all, I am sure. I do not want to imply that in any way. He has given us a very candid and forthright statement and I will certainly abide by your suggestion and wait until we get the full report or full investigation of this.

Mr. MAHON. Do you have any further question?

Mr. MINSHALL. Off the record.

(Discussion off the record.)

UPGRADING OF LIQUID ICBM'S

Mr. MINSHALL. For the past several days, we have discussed the advantages of ATLAS and TITAN and the upgrading and sophistication of these various weapons. I would like to ask you whether you feel it is more important that we upgrade and sophisticate, or more or less goldplate these weapons, rather than have more of the weapons that are presently available in the missile lag period when it is going to be the greatest, in 1962?

In other words, are you in favor of sophistication or more missiles?

Mr. MAHON. Or both?

Dr. YORK. I am not the right person to choose between those. My view is that big, liquid missiles are going to be here to stay and it is important to continue to improve them.

The upgrading of TITAN through obtaining the capability for the use of noncryogenic propellants, and other things being done in connection with this program, these are important milestones in the progress of big, liquid missiles. It is a separate question to ask, how many missiles should be had? There is no direct interference in terms of manpower, facilities, or things of that sort, between the program

for upgrading TITAN on the one hand and a possible program for installing more ATLASES on the other hand. The responsibility for determining how many ATLASES there are to be, and whether or not some more ATLASES ought to be bought, does not fall within the purview of my office.

Mr. MAHON. That seems to be perfectly clear.

The military people have to decide whether the need is great enough.

Mr. MINSHALL. That satisfies me.

Thank you, Mr. Chairman.

Mr. MAHON. I would like to ask you a few questions more or less around this same issue.

B–70 VERSUS B–58–X

You discussed the B–70 a couple of days ago in some detail. I do not want to rehash that discussion, but the meeting adjourned before we got into the B–58 and I would like to know what your evaluation is of the B–58. As you know, the Department of Defense in making up the 1961 budget had a lot of trouble with the B–58. It was out of the program for a time and it appeared that it would be canceled. Then later on it was decided that a few additional B–58's would be ordered and discussion was had about an upgraded model of the B–58.

If that plane is good, let us have it. If it is not good, then let us not have it.

What is your evaluation of this weapon?

Dr. YORK. You mentioned two things which I make a distinction between; the B–58 which we now have and the possible upgraded B–58 called the B–58–X.

As far as the B–58 is concerned and the question of whether they should be bought or not, this is strictly an operational problem. It involves factors of how important is it to have a dash capability for penetration at the end, and how important it is to have variety in our attack force.

The Air Force has determined it is important to have both of these, and the B–58 is a suitable weapon and, from the technical point of view to provide them.

I concur in the decision to buy some B–58's for the inventory. I really do not have much of an opinion with regard to the numbers, whether it should be 100 or not. The particular choice appears perfectly plausible.

With regard to the upgrading of the B–58, this is more of a technical problem and I have discussed it at some length with my own staff and with Air Force experts on the subject. We see it in general terms as follows: The B–58–X, from a strictly technical point of view, I think everyone knows what that is. It is a modified B–58 and a number of changes on the new engines are installed, so that it can have a longer range, and so that this longer range can be supersonic all the way. It, in fact, is a little bit faster than the B–58 by ——— of a mach number. In terms of range and in terms of altitude, and so on, it is not quite as good as the B–70, although it is nearly as good.

I do not have the precise figures on its range but its range is ——— percent less, perhaps. Its altitude is somewhat less. Its payload carrying capability is very much less. Its penetration should be pretty good because its ——— compares with ———. However, it represents perhaps, not the end of the line, perhaps not precisely the end of the line, but very nearly the end of the line in a development of the state of the art that existed in 1953 or 1954, which was the time period when the B–58 was laid down.

It is upgraded but it is still basically the state of the art that existed at that time, while the B–58 on the other hand, is based on the state of the art that existed——

Mr. MAHON. The B–70, you mean?

Dr. YORK. The B–70 is based on he state of the art that existed in 1958 or 1959. Of course, this wil be further developed, but the design is based on the state of the art that existed something like 5 or 6 years later than that which existed when the B–58 was laid down.

What we are doing, in effect, when we do compare these airplanes, is that we are comparing the extreme extrapolation in an early stage of the art with the very first extrapolation of the new state of the art.

Just as the B–52–A's progressed and the B–58 itself, with regard to performance in the first versions, the B–70 also has growth potential. I do not know what it is, and nobody else can say what, but in range, speed, and so on, people estimate that perhaps a 50-percent growth in speed. We can argue what that is worth but people have always been uncertain about what improvements would be worth.

It is on these grounds that we technical people would favor, if there were a matter of choice, between the B–70 and the B–58–X, we would favor going ahead with the B–70 because it represents a sizable jump in technology which can be, no doubt, further extended if that is desired.

The other factors involved in the issue are operational. When could you have it?

I have heard discussions involving certain details of the number of crew members, the way these crew members are arranged in the airplane, and so on, which also favor the B–70.

One further technical advantage in the B–70 over the B–58, which does not have so much to do with this matter of the state of the art or the time at which it was instituted, has to do with the volume of the B–70.

The B–70 is a bigger airplane and is much roomier inside and that means that there is much more flexibility in design available to the designer of the various kinds of electronic components that you need, such as the bomb navigation system, electronic countermeasures, and matters of that sort.

The fact that it has a bigger volume has been taken advantage of in the design of these electronic components in that it is planned to arrange them so that repairs or replacements, which are the equivalent of repairs, can be made in flight. These things are connected with the larger volume available. It is a more expensive program, of course, but a factor which is argued and which depends on what you count,

and how good your estimates are. It is more than twice as expensive for the first 100 airplanes.

I do not know how much more than twice as expensive, but I do not think it is an awful lot more.

From a technical point of view, the B–70 represents a big step and is a starting point for further progress.

The B–58 represents an ending point in progress for another type of airplane.

There were similar decisions faced in the past, not by me, but in connection with the institution of the B–52 at that time; there were proposals to build a B–47–X which could have been almost as good as the very first B–52. Had we made the decision to build a B–47–X at that time, we would be in a much poorer position than we are today.

Mr. MAHON. What was your recommendation, if you made a recommendation, with respect to whether the B–58 should be in the fiscal year 1961 procurement budget?

Dr. YORK. I made no recommendation on the subject of the B–58.

B–58 AS LONG-RANGE INTERCEPTOR

Mr. MAHON. In view of the fact that we canceled the F–108, would it be wise to undertake to use the B–58 in a dual role; namely, as a fighter as well as bomber?

Dr. YORK. There are other alternatives; namely, improvements in existing Century series which we are considering. I tend to look favorably on the use of manned interceptors in air defense. We have been studying, with the Air Force, what can be done in the way of up-dating some airplanes and we have considered all sorts of airplanes in the way of providing them with better air-to-air missiles, better search and identification equipment. The B–58 is a possibility for that purpose, but not the only one. In fact, it is one of the most expensive possibilities.

Mr. MAHON. Do you think it would be wise for Congress to go along with just the two prototypes of the B–70 and see what can be accomplished and what the need might be at that time?

Of course, you explained the other day that there were other things that would be necessary in connection with the weapons system. That should progress at the same time, but do you think that is reasonably adequate under the circumstances?

Dr. YORK. I think it is reasonable. It certainly is one of many reasonable ways to proceed. The speed at which you proceed in a program like this depends on both how fast technology can be pushed and on when you think this instrument needs to be available for the operational forces.

In this particular case, the technology could be pushed faster. Frequently, we find a program in which it would not pay to push it faster because you do not know enough. I do not believe that is true in this case. However, I think that the time period in which it is needed is such that it is reasonable to go along at about this rate, but whether it is exactly the right rate or not, I am not quite sure.

I think a little bit bigger might be sounder.

POSSIBLE ACCELERATION OF B–70 PROTOTYPE PROGRAM

Mr. MAHON. If you can identify at this point in the record what "a little bit bigger" program would consist of, cost-wise and otherwise, I wish you would insert that at this point.

Dr. YORK. I would have to be guessing but I am talking about $25 million or something like that.

It is difficult, incidentally, to estimate because of the way money spends out as contrasted with how it is appropriated. In a program where the NOA has rapidly changed downward, there is more money being spent in 1961 than probably the actual NOA. I do not have a good estimate on how to put this in budgetary terms, obligational terms.

USEFULNESS OF MISSILE BASES IN 10 YEARS

Mr. MAHON. Looking at this issue which I am about to raise, from a scientific standpoint, I wish you would tell us what you foresee by way of development in missiles that would affect the longevity of the ATLAS-TITAN type missile.

We are spending far in excess of $50 million a base to put in these missiles.

Dr. YORK. Yes, sir.

Mr. MAHON. Do you think the state of the are will progress to such an extent that in 5 to 10 years these vast expenditures will have served their only useful purpose and we will have to resort to other types of weapons?

Dr. YORK. That is the bases themselves?

These big rockets will be in use 5 or 10 years from now and certainly in connection with military space programs and civilian space programs.

Mr. MAHON. I am talking about the bases.

Dr. YORK. You are talking about the bases.

There are technical developments coming along that have a bearing on the problem, and I can mention what they are, but it is not obvious to me that they show that we will have, and be glad we have, these big rockets 5 and 10 years from now.

DEVELOPMENT OF SMALLER MISSILES

Most of the programs connected with advances in missilery are in the direction of making better small rockets. This includes such things as the MINUTEMAN, which we all know, and includes an increase in range of POLARIS. That makes the POLARIS a more flexible and a more valuable weapon, but still with a small payload and still with an accuracy which has in it not only the problems of guiding the missile but of knowing where the submarine is.

There are possible followons to the MINUTEMAN type of rocket where you build a still smaller rocket in order to have still greater mobility, perhaps to the point where you can have road mobility as well as rail mobility.

I am certain that if we wanted to, we could make a good ICBM down in the 20,000- or 25,000-pound class. How good it is depends on judgment about what you need for payload, but you could probably build something with ——— kilotons of explosion—and that is a

pretty good explosion—down in the 25,000-pound class. That kind of thing could probably be done in the late sixties. That again, is a smaller missile than the big ones.

So that most of the things we are looking at are in the direction of smaller, and smaller means both smaller in yield and also never quite as good in CEP as you can do with a good one just because you can get more steering wheels and stuff on board a big one than a little one.

There are some possibilities for actually increasing payload and accuracy without increasing size of rocket through what is called an aero ballistic missile. These aero ballistic missiles may turn out to be just a special adaptation of special new payloads for the existing rockets. Even if we do go that way, we may still fire them out of the same bases and the same rockets.

These are payloads that work by being accelerated to lower velocities than are needed for a ballistic trajectory to get from here to there. Typically, an intercontinental ballistic missile requires about mach 25 to go an intercontinental distance. These aero ballistic missiles are payloads where the idea is to accelerate them only to mach 15, for example, but you lift them to altitudes of only 100,000 or 150,000 feet where there is still a certain amount of air and they get lift from the air which extends the range over what mach 15 would otherwise give. This allows an increase in payload, it allows the possibility of terminal guidance and things of that sort. This is another possibility. This one, however, would probably lead to the further retention of the big missiles.

Mr. MAHON. We might have the big missiles in our silos 20 years from now?

Dr. YORK. I suppose. Like all our programs, they will not be the first missiles we put in, but there will be product improvements in them. I think we will 10 years from now still have big liquid missiles of about this size. In fact, we will probably even have these same missiles.

Mr. MAHON. Despite the vulnerability to zeroed-in attack of the opponent?

Dr. YORK. I forgot that. That is the other major technical advance that has an influence on this problem. With the kind of hardening that is being used on the last squadrons of each, ATLAS and TITAN, zeroing-in is quite a job. They can survive quite a near hit and even at CEP's like 1 mile, it takes ——— bombs to get a ——— percent certainty of knocking out something which is hardened to a hundred pounds per square inch.

Mr. SIKES. What megaton yield are you talking about?

Dr. YORK. I am talking about, say, ——— megatons, which is the sort of size yield you can get in big rockets like we have and like the Soviets have. If they go to MINUTEMAN size—this is an interesting point of what their progress is going to be—if they go MINUTEMAN size, they will require a larger barrage in order to knock out those big missiles which we have hardened.

RELIABILITY OF ELECTRONIC DEVICES UNDER WARTIME CONDITIONS

Mr. MAHON. I would like to ask you briefly if your Office is cooperating with the services in an effort to determine what may happen

to all these electronic devices that will be employed under actual war conditions. We have been told about a study at Fort Huachuca which is to cost $18 million or more and last 2 or 3 years. There is considerable skepticism as to the reliability of these expensive gadgets under wartime conditions. Will you discuss that, please.

Dr. YORK. I am sure you realize that is a continuing problem. It is not the kind of problem you get together and solve and it stays solved. It is a continuing problem because new weapons are always being introduced. In the past at least they have been getting, electronically speaking, more complicated. There are in each of the services programs with regard to this problem and also the Joint Chiefs of Staff are involved. They have a frequency application panel or board and there is a committee of the Joint Chiefs called the Military Communications and Electronics Board which deals with this problem and with which we work.

We have been making joint studies with them and with people from the Office of Assistant Secretary McGuire, who also is involved in communications and electronics problems and frequency allocation, and things like this.

At Fort Huachuca the Army plans to set up in the field a complete line of equipment such as might be used and disposed as it might be used by the Army in the field. They plan to probe the radiations which exist and find out what it is that is in the air. Then, using this information, by both theoretical calculations and by experiment, find out how these signals, which are everywhere, would affect new equipment.

The Air Force has a program, I believe they may even be requesting emergency funds for this one soon, to carry out similar studies. They are planning to find out what emissions come out of the various kinds of equipment they have. Then they plan to use computer techniques to tell them what the field situation would be. Then the result of these computations will be to say that at such-and-such a place you can expect these frequencies and these intensities.

Then to extend it they intend to reproduce these at low level but close to other equipments to find out what the interference would be.

In connection with BOMARC—if you will pardon the expression—we had a problem of this sort in which procedures such as I am describing were carried out in a more elementary fashion. It was discovered there would have been interference with BOMARC, and then that was corrected.

The Navy does similar things. The Navy has out at the Naval Electronics Laboratory a mockup of a ship in a wire cage so that it does not interfere externally, again a complete set of their equipment to detemine the intereference in that case between all of the equipment on one ship, all equipment that has to be placed in relatively close proximity to a great deal of other equipment.

In addition, we are preparing—Mr. Bridges in my office, in electronics—he is preparing as a result of work he has been doing with the Chiefs and with McGuire's office some standard procedures which developers are to carry out in connection with equipments like this, determinations that they are to make of all of the various frequencies which an equipment can produce, either accidentally or on purpose, for the purpose of providing this information to a central clearing-

house that will, hopefully, be able to consider what is going on and what effect it would have.

How well all of this works and how well all of this complicated information can be coordinated is a key question.

Mr. MAHON. To spend billions of dollars on equipment and then find, with amazement and consternation, that under wartime conditions it would not work would be a terrible thing.

Dr. YORK. That is the last thing I mentioned. We are, hopefully, setting up laboratories, doing work, setting up procedures that can handle this. It is an extremely complex problem. You can ask how well all of this is going to work. That I cannot quite answer because we are not far enough along.

Mr. MAHON. Are you very optimistic about it?

Dr. YORK. I am hopeful about it.

Mr. MAHON. Do you think we are going to get some much better answers than we have had before with respect to these questions?

Dr. YORK. Yes, we will have better answers than before, and the situation will get more complex than before, and we will need better answers. How well we will keep ahead of the situation really depends on how good all of the people involved in this problem are.

Mr. FORD. Will the gentleman yield?

Mr. MAHON. Yes.

Mr. FORD. You seem to indicate each of the three services has a different method or technique for determining these questions.

Dr. YORK. Yes.

Mr. FORD. Can the Army through this computer system simulate conditions such as the Air Force is doing? If so, would it be cheaper and more desirable than the Army method at Fort Huachuca?

MAJOR PROBLEM IS COORDINATION BETWEEN SERVICES

Dr. YORK. I think the two are complementary. This problem is so difficult that it is a good idea to have complementary methods here just to make sure you have not outsmarted yourself in either one or the other.

The problem we are facing and working with the services on is how to get the maximum correlation and coordination between these approaches so that what is uncovered in one case by one set of procedures that might have been overlooked in another can be brought to the necessary people's attention. This is a quite considerable problem in coordination. I think we are making progress on it. As I say, it keeps getting worse all the time simultaneously. I am hopeful that we are making progress faster than complexities are increasing.

CONTRACTS FOR "GOLD-PLATED" RESEARCH PROJECTS

Mr. MAHON. Dr. York, there is the question of the practical application of these weapons. That question makes appropriate my reference to a quotation from Missiles and Rockets magazine of March 7, 1960, an editorial by Clark Newton. He says:

> There is little question that many dollars have been spent on farfetched ideas that have no basis in practicality or even in possibility. By the same token, contractor management has often sold gold-plated research and development projects to the military, knowing them to be without merit and certainly

unworthy of their own company-supported financing. To many the Government appears as a benevolent grandfather bestowing largess on a favored few.

I would like you to comment on that.

Dr. YORK. As long as you keep that general enough, it is true to a certain extent.

Mr. SHEPPARD. May I ask a question at that point, Mr. Chairman.

Mr. MAHON. Yes.

Mr. SHEPPARD. In the field of this scientific research, has this tendency not been evidenced in the past as well as in this particular situation?

Dr. YORK. I think it is much more applicable to development than it is to research. So it is a growing problem.

Mr. SHEPPARD. I think history shows there were many failures as against successes in the inception. I mean as far back as Edison. Generally speaking, this is nothing new. It is more or less a characteristic of anything in that particular research and development environment, is it not? I mean the law of averages, failures, and successes, and so forth.

Dr. YORK. Failures and successes, yes. The reference is to gold plated, which I think of as being unnecessarily overelaborate things. That is something which may in fact be getting worse. Furthermore, in research I think it is not as true as it is in the realm of development.

Mr. SHEPPARD. Your experience indicates the Federal Government is not buying too many of the gold-plated projects or is it?

Dr. YORK. No; that is why I said if you keep it general enough, it is true. It is hard to identify. This is the sort of thing that you feel rather than that you can say that here is a fine example.

Mr. SHEPPARD. Thank you, Mr. Chairman.

CHARACTERISTICS OF SOVIET BALLISTIC MISSILES

Mr. MAHON. Mr. Sheppard has a question.

Mr. SHEPPARD. What is the comparability between our type of ballistic missile and the missile fired by the Soviets into the Pacific insofar as utilization of the power stages is concerned? Is there a comparability of the structure aspect or are they operating upon what was originally the old buzz bomb concept?

Dr. YORK. Theirs are true rockets of a design similar to the ATLAS or TITAN type of design.

Mr. SHEPPARD. They are multistage rockets?

Dr. YORK. Yes.

Mr. SHEPPARD. That is all.

Mr. MAHON. Mr. Sikes.

NEED FOR LARGE YIELD WARHEADS

Mr. SIKES. Dr. York, we are talking about yields in warheads for ballistic missiles. Is that the upper range of practical yield limit for these weapons?

Dr. YORK. There is no nice cutoff for the type of rockets which we are now using and uprated but not changed by a large factor or the kinds of yields we can get.

Mr. SIKES. Are there perhaps targets that would require a higher yield than that?

Dr. YORK. The kind of target that requires yields that large or larger is hard targets that you want to destroy. This may include missile pads and, of course, as people point out, there probably are not any missiles in these missile pads. But there are other kinds of hard targets such as ——— centers. In the United States we have quite a number of centers that we regard as so important that we take great pains to harden them.

That means that we regard it as very important to preserve. If there are targets that we or our enemy regard as important to preserve, by definition, it is important to the other fellow to blow these up. There always is a difference in what is important, depending on whether you are simply going to retaliate or possibly do more than just retaliate. These are operational issues.

INTERCEPTION OF HONEST JOHN ROCKET WITH HAWK

Mr. SIKES. A few weeks ago the Army announced that by the use of a HAWK interceptor it had killed an HONEST JOHN rocket. In other words, a faster than sound antiaircraft rocket intercepted another supersonic missile.

Is that particularly significant insofar as it offers promise for future development in that field?

Dr. YORK. It is more in the nature of a demonstration. It shows that within limits you can in fact intercept a bullet with a bullet. How significant that is to an individual depends on whether he doubted that could be done in advance or not. I would not have doubted that a HAWK could intercept an HONEST JOHN; so to me, personally, it was not significant.

To put it even more strongly, I have no doubt that a HAWK on a test range can intercept an HONEST JOHN fired on a test range by technical people at other technical people as a demonstration of a technical triumph. It is a little difficult to say how that would work on the battlefield under conditions of chaos.

(Discussion off the record.)

DETECTION OF SATELLITES

Mr. SIKES. We had quite a bit of speculation in the press a few weeks ago about an unidentified satellite in orbit around the earth. Later it was decided that this was the second stage rocket of one of our DISCOVERER satellites with which contact had been lost.

I was quite disturbed by the fact that we could not even pick up our own satellites and identify them without such a lapse of time. It gave me cause to worry about our ability to identify any other satellites or other weapons. Do you attach any particular significance to this situation?

Dr. YORK. It is a fact that our present detection system has a rather limited capability. It means that as of today someone could put up satellites that might go undetected for actually quite a long time. There are a number of things I can say about that.

When BMEWS comes in, any polar satellites would be detected by BMEWS. In fact, one of the reasons for being interested in being able to track satellites, get a good fix on their orbit, is so that this can be supplied to the BMEWS sites in such a way so that every time

the satellite comes over they do not identify it as a false alarm missile.

That is BMEWS, which was designed for a different purpose and is geographically limited to polar satellites. This effort is centered in the Advanced Research Projects Agency where we are reviewing what should be done with regard to satellite detection, what you might call a satellite fence.

There are a number of possibilities. As you know, the Navy has installed under ARPA's direction a radar fence across the Southern United States. This fence can be improved if desired. At the present time it has a gap in the middle of it and also the power in the radars can be increased. You can do other things like increasing frequency, which would improve it also.

However, other rather different approaches to the problem, still using radar but radars of a different design, are also under consideration and appear to be roughly the same cost. To make a crude estimate, to have a good satellite fence that can detect satellites down to fairly small size—and by small size, always referring to what is called the radar cross section, this is for somebody not trying to specially confuse matters, it is about the size of the object—but sizes down to a tenth or a hundredth of a square meter and a distance like a thousand miles, a system that can do this would cost on the order of $50 million to $100 million. It can be done.

The question is: How urgent and how important is it to do? I have assigned this problem primarily to ARPA. We are trying to work out what it is we ought to do in this field.

NEED FOR EAGLE MISSILE SYSTEM

Mr. SIKES. The Navy is proposing the new EAGLE missile and the Missileer, a new plane from which to launch it. I believe you stated this may run into a billion-dollar program in developing and testing. Are there other ways which this same job can be done with modification of present weapons or planes at a considerably lower cost?

Dr. YORK. There are ways to do similar jobs. The Navy is convinced that this is the most effective way of doing it in the future, the one with the most promise of being successful.

For example, the EAGLE missile could be put on other aircraft, but the other aircraft that are available cannot take as many and cannot stay up as long. Having more and being able to stay off the carrier deck for a longer period is something which is operationally very desirable. It is like most of these things, there are other ways to do similar jobs. This is a better way. The Navy has to consider very carefully the question of whether this much improvement is worth it. At the present time they believe it is.

On the other hand, I know that it is a problem that troubles them—maybe troubles is too strong a word—but it is a problem they are concerned about. Will they indeed be able to carry this program to conclusion?

MIDAS DETECTION SYSTEM

Mr. SIKES. You say MIDAS is a satellite-based detection system employing infrared sensors which could detect the great blast of heat accompanying an ICBM launch and is being vigorously pursued.

What would MIDAS show in the case of a large, hot forest fire or a ship explosion like the one at Texas City a few years ago, or the burning of the oil tanker and the accompanying burning of gasoline storage tanks at Galveston, or Houston, last year? Would a situation of that kind be picked up by MIDAS?

Mr. FLOOD. And also, if I may add this, explosions of meteors of the classification of four in Asia in the last 10 years?

Dr. YORK. To answer both of those, Mr. Sikes first, there are two ways of getting around either all or most of the things you mention. One we plan to employ from the very beginning; the other probably is a sophistication which will be added.

It is possible that certain enormous fires that were able to get an air circulation to bring hot air in significant amounts would be bothersome. There are thunderheads that occasionally reach above altitudes like that that may be bothersome. There is a problem there.

Mr. FLOOD. Except this, the MIDAS is to pick up at point of discharge, or at least to help us, beginning at the point of launch.

Dr. YORK. Off the record.

Mr. FLOOD. As far as you are concerned, when we or you say "the point of launch" you mean ———. That is the same thing?

Dr. YORK. Yes.

(Discussion off the record.)

Mr. FLOOD. Meteor trails of high intensity of light and of heat—at least as far as your terms are concerned, they are almost synonymous—are not uncountable. I am advised in the area of the world from which your MIDAS would be looking for some reason they are especially common or more common than they are in our area.

I have heard this explained. This is not an uncommon natural phenomenon.

Dr. YORK. Big ones are. Small ones, you can look up and see them at night. They, in general, won't look to the MIDAS like a rocket would look.

Mr. MAHON. Are there any further questions, Mr. Sikes?

Mr. SIKES. I believe not.

COMMENDATION OF DR. YORK

Mr. MAHON. Dr. York, your testimony has been most helpful and most interesting. You have a grasp of facts and a capability of expression which is almost without parallel in witnesses who appear before this committee.

As I have sat here and listened to you, I have thought that a man of your persuasiveness could be tremendously useful in the Pentagon, but if a man of your persuasiveness should happen to be wrong about an issue, it would be most disconcerting, so please seek to be right in your decisions.

Dr. YORK. I could be doing something else with the time, I suppose, but I think it is fine. I have no objection.

Mr. SHEPPARD. I might suggest, Mr. Chairman, if it is not intruding upon your prerogative, sitting here listening, not only to the statements of this gentleman, but to his explanations to the inquiries, that if you want to save time of personnel it might be well if you

left a few of the other witnesses home and send down this particular gentleman. I think we would be likely to get farther with less complications and misconstructions and interpretations of testimony.

Mr. LAIRD. Mr. Chairman, it seems to me that Dr. York must put in many, many hours doing his "home work." I have never seen a witness as well versed on so many different aspects of our defense program as Dr. York.

Mr. MAHON. How do you do this, Dr. York?

Dr. YORK. It is what you have to do in order to do the job, anyhow. It is not extra time.

Mr. FORD. I would like to echo what the chairman said, Dr. York.

Dr. YORK. Thank you very much.

Mr. FLOOD. I could not do it better myself.

EMERGENCY FUND, DEPARTMENT OF DEFENSE

WITNESS

DR. HERBERT F. YORK, DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

Program and financing

	1959 actual	1960 estimate	1961 estimate
Program by activities: Research and development contingencies (reserve for transfer) (undistributed)		$140,950,000	$150,000,000
Financing:			
Unobligated balance transferred to "Salaries and expenses, Advanced Research Projects Agency, Department of Defense" (73 Stat. 377)		15,000,000	
Unobligated balance transferred from "Aircraft, missiles and related procurement (Air Force)" (73 Stat. 377)		−15,000,000	
Unobligated balance no longer available	$7,806,750		
New obligational authority	7,806,750	140,950,000	150,000,000
New obligational authority:			
Appropriation	150,000,000	150,000,000	150,000,000
Transferred (72 Stat. 713; 73 Stat. 377) from:			
"Reserve personnel, Navy"	2,000,000		
"Operation and maintenance, Air Force"	3,000,000		
"Aircraft, missiles and related procurement (Air Force)"	10,400,000		
"Procurement other than aircraft and missiles (Air Force)"	18,500,000		
"Military personnel, Army"		$5,550,600	
"Research, development, test, and evaluation, Navy"		5,500,000	
Transferred (72 Stat. 713; 73 Stat. 377) to:			
"Salaries and expenses, Secretary of Defense"	−$751,000		
"Salaries and expenses, Advanced Research Projects Agency, Department of Defense"	−51,900,000	−19,400,000	
"Research, development, test, and evaluation, Army"	−43,004,000	−650,000	
"Research, development, test, and evaluation, Navy"	−39,408,250		
"Research, development, test, and evaluation, Air Force"	−41,030,000		
Appropriation (adjusted)	7,806,750	140,950,000	150,000,000

Mr. MAHON. I want to ask you what you think of the techniques we have employed with respect to the emergency fund. We have tried to get more value for the dollar appropriated by giving certain flexibility through the emergency fund. Will you tell us what you think about that technique.

Dr. YORK. I am very strongly in favor of the emergency fund and find it extremely useful as a means for introducing new things quickly—by that I mean quickly compared to the time it takes in the usual budget cycle—and without having too great a reprograming

situation, which is also desirable. Reprograming is useful and necessary at times, but, if carried to extremes, it merely creates havoc and uncertainty everywhere. The emergency fund has been an extremely useful means for introducing new research, development, sometimes test programs, quickly.

STATEMENT BY DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

Dr. YORK. Mr. Chairman and members of the committee, I am pleased to appear before this committee again to discuss the Department of Defense emergency fund. For a number of years the Congress has provided the Secretary of Defense with certain funds augmented by the authority to transfer other appropriated funds for the purpose of facilitating the research and development programs of the Department. This emergency fund together with the transfer authority has served to advance military technology far out of proportion to the amount of money involved.

There is attached a table indicating the amounts which have been appropriated and the amounts of the transfer authority directly related to the emergency fund appropriations since 1954 which, if the committee desires, may be placed in the record.

The fiscal year 1961 request for this appropriation is the same as provided for the current fiscal year—$150 million in new obligational authority and $150 million of transfer authority. In the course of our continuing efforts in the Department of Defense to increase the basic store of scientific knowledge and to apply such knowledge to the development of improved weapons and military equipment, it is not always possible to predict the rate at which such investigations will progress. Many times, work in progress will suddenly demonstrate new areas of research or development which warrant resources in addition to, or earlier than those previously planned. Such situations can occur at any point in the research, development, test, and evaluation cycle or at any time during the budget year. Under current world conditions, it is essential that the Department of Defense have the fiscal capability to exploit instantly any new scientific, developmental, or test opportunity. While unable to predict precisely where or when they will occur, we can expect profitable opportunities to arise in such fields as ballistic missile development; antisubmarine warfare; defense against ballastic missiles, including detection and warnings; satellites and other space programs; computer techniques; advanced scientific instruments of a major nature; and material and component development.

Each year, the service research and development programs are reviewed and balanced in an effort to assure that the funds provided cover only those projects considered to be of highest priority. New opportunities for R. & D. which arise later can sometimes be satisfied at the expense of other going projects, but it is not always in the best interest to select projects which can be eliminated or reduced. The emergency fund has been employed in recent years to exploit, promptly, sudden technological breakthroughs or satisfy unanticipated needs while at the same time avoiding the disruption of the current research and development programs.

The emergency fund provides the Department of Defense with the needed capability to exploit promptly unexpected technological break-

throughs or to handle late developments, regardless of the military department in which they occur. Also, by providing the funding flexibility in a single place, subject to the direct control of the Secretary, it is possible to provide far greater flexibility than would be the case if the individual research and development appropriations of the military departments were increased by the same amount.

In the past years, the emergency fund has been used to initiate such important developments as the Army's JUPITER, the Navy's POLARIS, and the Explorer satellite program. It has helped to support such projects as the Air Force's X–15 program, the Midas and Discoverer programs and the Navy's ASW program. The emergency fund has also been used to accelerate basic research and materials research and investigations involving electron tubes and parts. Attached are tables showing the utilization of the emergency fund for the years fiscal year 1956 through fiscal year 1959 which, if the committee desires, may be placed in the record.

In the current fiscal year, the emergency fund has been used to support items such as the Discoverer project and the seismic research aspects of the Vela project. The latter project is related to the control of nuclear tests. Again, there is attached a statement on the fiscal year 1960 emergency fund which indicates the amounts already transferred and the currently pending proposals for its further utilization during the remainder of the year. This may be placed in the record if the committee desires.

To recapitulate—for fiscal year 1961, the Department of Defense requests $150 million in new obligational authority for the emergency fund for research, development, test, and evaluation or procurement and production related thereto, plus the authority to transfer up to $150 million from other appropriations available to the Department of Defense for obligation during fiscal year 1961. The emergency fund appropriation represents an important management tool which the Congress has provided for the Secretary of Defense. Such funds have proven to be very useful in the past and, considering the ever increasing complexity of our research and development efforts, it is my firm belief that in the future the capability provided by the emergency fund will prove to be even more important and useful in managing the R.D.T. & E. and related programs.

By memorandum of November 13, 1959, we revised earlier instructions and principles governing the submission, review, and approval of emergency fund requests. A copy of this memorandum has been made available for inclusion in the record if you so desire.

(The following tabulations were submitted:)

Amounts which have been appropriated and the amounts of the transfer authority directly related to the emergency fund appropriation since 1954

	Fiscal year 1954	Fiscal year 1955	Fiscal year 1956	Fiscal year 1957	Fiscal year 1958	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961 request
Appropriations	60.0	25.0	35.0	85.0	85.0	150.0	150.0	150.0
Transfer authority			50.0	50.0	150.0	150.0	150.0	150.0

Fiscal year 1956 emergency fund transfers, year end report

1. Availability:	
Appropriation	$35,000,000
Transferred in	50,000,000
Total available	85,000,000
Transferred out (details listed below)	84,729,000
2. Details of transfers in:	
Army	19,500,000
Navy	20,500,000
Air Force	10,000,000
Total	50,000,000
3. Details of transfers out:	
Army:	
1. Support of International Geophysical Year	1,000,000
2. Scatter communications research	750,000
3. Classified NSA projects	2,500,000
4. LITTLE JOHN	2,000,000
5. JUPITER support	10,000,000
6. Anti-Ballistic Missile program	1,420,000
7. AFSWP	930,000
8. Food irradiation	600,000
Total	19,200,000
Navy:	
1. Project VANGUARD	15,500,000
2. Lineal programing	80,000
3. Radome materials	870,000
4. Nuclear seaplane	3,600,000
5. IRBM No. 2 support	16,900,000
6. Communications research	2,229,000
7. ASW Missile System	1,300,000
8. IRBM No. 2 solid propellant	850,000
9. Glycerol freezing of blood	114,000
10. Project PAMOR	775,000
Total	42,218,000
Air Force:	
1. Aircraft nuclear propulsion	15,500,000
2. IRBM No. 1 development	4,000,000
3. Electronic Tube Development	2,000,000
4. Missile Test Instrumentation	1,000,000
5. Project VANGUARD	611,000
6. Facilities Planning	200,000
Total	23,311,000

Fiscal year 1957 emergency fund transfers, year end report

1. Availability:	
Appropriation	$85,000,000
Transferred in	13,000,000
Total available	98,000,000
Transferred out (details listed below)	86,272,028
2. Details of transfers in:	
Navy	13,000,000
3. Details of transfers out:	
Army:	
1. NIKE-TALOS	22,500
2. Medical research	400,000
3. Tank gun developments	1,678,400
4. HONEST JOHN	3,310,000
5. Free radical feasibility study	1,190,000
6. High economy engines	2,000,000
7. Operation HARDTACK	6,122,628
8. Classified project	2,000,000
9. Classified project	4,950,000
10. Communications research	300,000
11. Battle area surveillance work	700,000
Total	22,673,528
Navy:	
1. Project VANGUARD	30,800,000
2. JUPITER	13,000,000
3. Free radical feasibility study	30,000
4. Aircraft data presentation	2,500,000
5. Tactical data system	3,300,000
Total	49,630,000
Air Force:	
1. Engine development project	2,200,000
2. Long range aviation facilities study	53,500
3. X–15 aircraft	10,315,000
4. Solar furnace	1,400,000
Total	13,968,500

Fiscal year 1958 emergency fund transfers, year end report

1. Availability:	
Appropriation	$ 85,000,000
Transferred in	149,513,000
Total available	234,513,000
Transferred out (details listed below)	233,459,800
Transferred to O. & M. Army to take care of pay raise	1,053,200
Total	234,513,000
2. Details of transfer in:	
Army	62,100,000
Navy	36,013,000
Air Force	51,400,000
Total	149,513,000

Fiscal year 1958 emergency fund transfers, year end report—Continued

3. Details of transfers out:

Army:	
1. AFSWP tests	$5,150,000
2. JUPITER	35,000,000
3. Detection investigation	50,000
4. Back-up for U.S. S. satellite	3,500,000
5. Classified project	2,000,000
6. Fort Churchill IGY facility	395,000
7. Classified evaluation test	328,000
8. Radiological research	100,000
9. Food irradiation	2,500,000
10. Basic research	7,500,000
11. Telemetry	487,000
12. Electron tubes and parts research	5,451,000
13. Detection investigation	1,500,000
14. Materials research	3,100,000
15. AFSWP test requirements	3,150,000
16. Basic research longevity	6,000,000
17. NSA Research Institute	1,900,000
18 Free radicals study	1,000,000
19. Training devices	1,000,000
20. Test program White Sands Proving Ground	2,000,000
Total	82,111,000
Navy:	
1. Linear programing	$40,800
2. POLARIS	21,813,000
3. Backscatter measurement techniques	400,000
4. Tracking foreign satellites	1,085,000
5. Classified evaluation test	45,000
6. Atomic physics projects	600,000
7. Basic research	15,000,000
8. Van de Graaf generator	1,600,000
9. Materials research	3,600,000
10. Electron tubes and parts research	3,400,000
11. Radar techniques	230,000
Total	47,813,800
Air Force:	
1. Classified evaluation test	152,000
2. Basic research	7,500,000
3. Materials research	3,300,000
4. X-15 program	7,600,000
5. Electron tubes and parts research	3,933,000
6. BMEWS	950,000
7. Basic research longevity	6,000,000
Total	29,435,000
OSD:	
1. Classified evaluation test	1,000,000
2. ARPA	73,100,000
Total	74,100,000

Fiscal year 1959 emergency fund transfers, year end report

1. Availability:	
Appropriation	$150,000,000
Transferred in	33,900,000
Total available	183,900,000
Transferred out (details listed below)	176,093,250
2. Details of transfers in:	
Navy	2,000,000
Air Force	31,900,000
Total	33,900,000
3. Details of transfers out:	
Army:	
1. AFSWP tests	8,677,000
2. Classified project	12,500,000
3. Classified evaluation test	150,000
4. Materials Advisory Board	200,000
5. Fort Churchill IGY facility	267,000
6. Antiradiation research	1,600,000
7. Special chemical agent	210,000
8. Materials research	6,200,000
9. Detection	3,250,000
10. Chemical agent	3,000,000
11. Free radicals	150,000
12. Basic research	6,800,000
Total	43,004,000
Navy:	
1. Smithsonian Institution studies	155,250
2. Arctic research	750,000
3. Radar developments	3,000,000
4. Balloon research	500,000
5. Blood preservation	350,000
6. Torpedo research	853,000
7. ASW weapon research	3,700,000
8. Materials research	6,000,000
9. ASW detection	2,000,000
10. Special ASW project	3,000,000
11. ASW surveillance	11,000,000
12. Basic research	8,100,000
Total	39,408,250
Air Force:	
1. Classified evaluation test	450,000
2. Solid state electronics	2,000,000
3. MINUTEMAN	15,000,000
4. Aircraft fatigue studies	1,300,000
5. Electrostatic reconnaissance	950,000
6. Air Defense System integration	3,500,000
7. WSEG tests—Phase II	1,405,000
8. Storable liquid propellants	1,095,000
9. Materials research	7,800,000
10. Amplitron development	3,930,000
11. Terrain clearance radar	1,000,000
12. Basic research	2,600,000
Total	41,030,000

Fiscal year 1959 emergency fund transfers, year end report—Continued

3. Details of transfers out—Continued

OSD:	
1. Classified evaluation tests	$751,000
2. ARPA:	
MIDAS	12,000,000
DISCOVERER	34,400,000
High energy upper stage	5,500,000
Total	52,651,000

Status of fiscal year 1960 emergency fund as of Feb. 29, 1960

Availability:	
Appropriation	$150,000,000
Transferred in (transfer authority)	31,375,000
Subtotal available	181,375,000
Transferred out	44,845,000
Balance remaining available for transfer	136,530,000
Details of transfer in:	
From Army	(10,875,000)
From Navy	(5,500,000)
From Air Force (from prior year unobligated balance)	(15,000,000)
Total	(31,375,000)
Details of transfers out:	
To Army	(6,025,000)
To Navy	(0)
To Air Force	(4,300,000)
To ARPA	(34,520,000)
Total	(44,845,000)
Items under consideration in OSD:	
Total	141,032,000

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING,
Washington, D.C., November 13, 1959.

Memorandum for The Secretry of the Army
The Secretary of the Navy
The Secretary of the Air Force
The Director, Advanced Research Projects Agency
The Chief, Defense Atomic Support Agency
The Director, National Security Agency

Subject: Requests for allocation of funds from the Secretary of Defense emergency fund.

References: (*a*) Memo for Secretaries of the military departments and heads of joint agencies from the Deputy Secretary of Defense, subject as above dated October 25, 1956.
(*b*) Memo for Secretaries of the military departments and heads of joint agencies from ASD (R. & E.), subject: "Guidance regarding the use of emergency funds for research and developement", dated November 13, 1957.
(*c*) Minutes of the Research and engineering policy council meeting of July 30, 1959, dated August 13, 1959.

In furtherance of the discussions outlined in reference (*c*), the following guidance is established in regard to the use of the Department of Defense emergency fund.

The emergency fund, including the transfer authority provision pertaining thereto, is made available by the Congress to provide the Secretary of Defense with necessary funding flexibility. In part, this flexibility is required to fill program gaps promptly, to permit the prompt exploitation of technological break-

throughs, and to handle unexpected developments related to the research and engineering programs of the Department of Defense while, at the same time, avoiding the disruption of the current research and engineering programs which would be caused by repeated enforced reprograming in excess of the normal flexibilty available to the military departments under existing practices.

This office will initiate recommendations to the Secretary of Defense for allocations from the emergency fund when such actions are considered necessary to coordinate and expedite programs of joint interest. The programs to be funded from such allocations, if approved, will normally be administered by one or more of the military departments or agencies, with the selection to be made by mutual agreement.

Most of the recommendations for allocations from the emergency fund will be based upon requests originated by the military departments and agencies. To assist this office, in coordination with the Assistant Secretary of Defense (Comptroller), in developing recommendations for approval or disapproval by the Secretary of Defense of such requests for allocations from the emergency fund (including the transfer authority provision thereof), a detailed staff paper including the following information should be provided:

(*a*) Title, project number and description of the project or program.

(*b*) Total amount of funds requested and funding required on each phase of the project, contractor or laboratory names when known, distribution of effort by contract and inhouse operations, and the period of time to be covered by the proposed funding.

(*c*) Breakdowns by fiscal year of total previous funding, current funding approved for the project or program, the funding support contemplated in subsequent years to the extent possible to estimate, and the anticipated source of the required funds.

(*d*) Detailed shopping list for the emergency fund request and the related current year funding approved.

(*e*) Specific circumstances which render reprograming impracticable or the use of the transfer authority provision not feasible.

(*f*) The appropriation sources and the amounts to be derived from each if transfer authority is to be used.

The above data should be accompanied by a summary of the administrative, economic, operational, technical, and logistical circumstances which created the need for the additional funding, and any other information that would assist in justification of the use of the emergency fund. Such information should include planned operational dates, anticipated weapon and equipment replacements, influence on inventory, possible long-term savings in manpower and funds, and a discussion of anticipated increases in overall military effectiveness.

There should also be a description of the program management organization specifying the responsibility for the management and technical direction of the program, including lead technical bureaus, services or offices where applicable, and the offices, desks and/or laboratories charged with administration and technical direction.

This office will coordinate the review of emergency fund and related transfer authority requests for the Office of the Secretary of Defense. Accordingly, such requests should be addressed to the Director of Defense Research and Engineering and submitted in quadruplicate. The general principles which will be observed in the review of these requests by the Office of the Secretary of Defense are contained in the inclosure. In general, requests which cannot clearly meet the tests implied by these principles will not be favorably considered unless some special compelling circumstances are determined to exist.

References (*a*) and (*b*) are hereby superseded.

J. B. MACAULEY,
Deputy Director
(For Herbert F. York).

GENERAL PRINCIPLES TO BE OBSERVED IN THE REVIEW OF EMERGENCY FUND AND TRANSFER AUTHORITY REQUESTS

Principles to be recognized in the review are that—

(1) Special interim needs for additional funds may arise in the implementation of decisions made by the Secretary of Defense when the impracticability of using regular funds can be demonstrated and it is not feasible or desirable to wait until the next regular funding period.

(2) Certain programs which are of general interest to more than one military department or agency and are not of special interest to anyone may be of sufficient importance to warrant recommendations for additional funding on an interim basis where it is not considered feasible to require support under regular appropriations.

(3) During the current year, changed program requirements or significant progress may make it desirable to emphasize the exploitation of some technical situations, and it may then be desirable to provide additional or initial funding on an interim basis to avoid excessive revision of other programs funded under regular appropriations.

(4) Normally, the major fund requirements of a continuing project considered for emergency funding, and especially budgetary provision for its continuation, should be made under regular "Research, development, test and evaluation" appropriations; the emergency fund should, in such case, be considered only to the extent necessary to finance an interim increment of effort prior to the availability of the next regular appropriation.

(5) Each military department and agency has an extensive backlog of desirable projects, each of which, for one reason or another, lacks sufficient priority to be funded under the regular "Research, development, test and evaluation" appropriations. It is not valid to consider the emergency fund as an additional general source of funding to support such backlog projects, in view of statement (4) above.

(6) The regular "Research, development, test and evaluation" appropriations of the military departments and agencies are to be fully utilized to fund the highest priority and most urgently needed programs and projects of particular interest to each military department and agency.

(7) When available, transfer authority should be favored over use of the emergency fund, particularly for developmental projects and in situations where it is particularly necessary to control overall availability of funds and expenditures.

(8) Research and engineering programs, like other programs, are subject to change after initial planning, and normal changes should be adjusted within funds available under regular "Research, development, test and evaluation" appropriations. This applies particularly to major weapon development programs or components thereof, and the military departments should take appropriate administrative steps to assure reasonable flexibility to provide for normal reprograming requests.

(9) The emergency fund will not be utilized for the construction of facilities which would normally be financed through a public works program or considered as an industrial facility expansion project within procurement appropriations.

(10) Appropriation of an emergency fund each year does not mean that it should all be used.

Dr. YORK. The situation, roughly speaking, is, it is normally spent out fairly late in the year. The reprograming approach is normally used to handle these problems in the early part of the year. The emergency fund finds its greatest usefulness toward the end when the capability for reprograming has begun to disappear.

Mr. MAHON. You have a very good statement, I think the best statement we have ever had on that.

Mr. FORD. Mr. Chairman.

Mr. MAHON. Mr. Ford.

Mr. FORD. In the practical operation of the emergency fund, are your recommendations the principal ones that determine the final decisions?

Dr. YORK. Yes, that is correct. It then goes from me to the Comptroller, to the Secretary or Deputy Secretary, to the Bureau of the Budget. The reviews at those levels very largely deal with administrative matters relating to the propriety of using the emergency fund for a particular purpose, because at all levels we are interested in avoiding an improper use of the emergency fund that would lead to any question as to whether it ought to be continued.

Mr. FORD. What I was concerned about was after you made your technical decision, you have nontechnical people passing on technical questions.

Dr. YORK. It is like everything in the Government. There is a certain amount of that kind of problem, but as I said, the primary reason for all this is to make certain that we technical people are not careless with regard to how we use the emergency fund, with regard to using it improperly as a means for avoiding other kinds of rules rather than for meeting technical emergencies, and so on.

The Government does have redtape in it and it even applies to the emergency fund, but I cannot complain.

Mr. FORD. I gather from that last comment, then, that your recommendations from a technical point of view have not been denied in the majority of cases nor has there been an extremely long period or timelag between what you have recommended technically and the actual execution.

Dr. YORK. No. There is a timelag and there is a certain amount of argument necessary on some of these. Sometimes it even involves technical matters. The places where the nontechnical people put their strongest attention are with regard to these legalistic and administrative points as to whether this is a proper way to be using the emergency fund, considering what the Congress intended when it established this fund.

Mr. FORD. Thank you very much.

Mr. MAHON. If we need amplification, we will get in touch with you.

MARCH 11, 1960.

ADVANCED RESEARCH PROJECTS AGENCY

WITNESSES

BRIG. GEN. A. W. BETTS, DIRECTOR, ADVANCED RESEARCH PROJECTS AGENCY
WILBUR BOLTON, DIRECTOR, FINANCIAL MANAGEMENT AND REPORTS DIVISION
COL. DENT LAY, DIRECTOR, TECHNICAL OPERATIONS DIVISION

SALARIES AND EXPENSES

Mr. MAHON. We shall proceed now to the consideration of the Advanced Research Projects Agency.

JUSTIFICATION OF THE ESTIMATES

We shall place the budget justifications for ARPA in the record at this point.

(The information referred to follows:)

SALARIES AND EXPENSES, ADVANCED RESEARCH PROJECTS AGENCY

Program and financing

	1959 actual	1960 estimate	1961 estimate
Program by activities:			
Direct obligations:			
1. Military sciences	$46,632,193	$132,340,000	$144,000,000
4. Military astronautics and related equipment	103,068,549	111,913,744	67,000,000
8. Programwide management and support	3,170,546	4,000,000	4,000,000
Total direct obligations	152,871,288	248,253,744	215,000,000
Reimbursable obligations:			
4. Military astronautics and related equipment	1,997,000		
Total obligations	154,868,288	248,253,744	215,000,000
Financing:			
Comparative transfers to other accounts	238,161,744	113,246,256	
Unobligated balance brought forward	−67,583,806	−112,145,560	−39,795,560
Unobligated balance transferred to "Research, development, test and evaluation, Air Force" (73 Stat. 377)		19,600,000	
Unobligated balance transferred from—			
"Research, development, test and evaluation, Air Force" (72 Stat. 712)	−170,000		
"Emergency fund, Department of Defense" (73 Stat. 377)		−15,000,000	
Advances and reimbursements from other accounts	−1,997,000		
Unobligated balance carried forward	112,145,560	39,795,560	39,795,560
New obligational authority	435,424,786	293,150,000	215,000,000
New obligational authority:			
Appropriation	520,000,000	455,000,000	215,000,000
Transferred from—			
Aircraft, missiles, and related procurement (Air Force) (72 Stat. 712)	8,500,000		
"Emergency fund, Department of Defense" (72 Stat. 713; 73 Stat. 377)	51,900,000	19,400,000	
"Missile procurement, Air Force" (73 Stat. 377)		75,000,000	
Transferred to—			
"Military construction, Advanced Research Projects Agency, Department of Defense" (72 Stat. 1096)	−28,065,214		
"Procurement of equipment and missiles, Army" (72 Stat. 712)	−42,210,000		
"Research, development, test and evaluation, Army" (72 Stat. 712)	−15,500,000		
"Research and development, National Aeronautics and Space Administration" (72 Stat. 433)	−59,200,000		
"Research, development, test and evaluation, Air Force" (73 Stat. 377)		−256,250,000	
Appropriation (adjusted)	435,424,786	293,150,000	215,000,000

Object classification

	1959 actual	1960 estimate	1961 estimate
Total number of permanent positions	44	70	67
Full-time equivalent of all other positions	1	2	2
Average number of all employees	30	62	68
Number of employees at end of year	46	69	69
Average GS grade and salary	8.3 $6,968	9.3 $7,772	9.3 $7,852
Direct obligations:			
01 Personal services:			
Permanent positions	$232,055	$523,410	$582,635
Positions other than permanent	13,793	26,000	26,000
Other personal services	4,284	10,590	8,365
Total personal services	250,132	560,000	617,000
02 Travel	41,219	90,000	90,000
03 Transportation of things	2,383	12,000	12,000
04 Communication services	20,219	25,000	30,000
06 Printing and reproduction	4,296	20,000	20,000
07 Other contractual services	152,478,036	247,465,744	214,162,000
08 Supplies and materials	4,462	9,000	9,000
09 Equipment	55,217	35,000	20,000
11 Grants, subsidies and contributions	15,046	35,500	38,500
13 Refunds, awards, and indemnities		1,000	1,000
15 Taxes and assessments	278	500	500
Total direct obligations	152,871,288	248,253,744	215,000,000
Reimbursable obligations:			
07 Other contractual services	1,997,000		
Total obligations	154,868,288	248,253,744	215,000,000

Justification of Estimates, Fiscal Year 1961

Appropriation introduction

	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961
Appropriation or estimate	$520,000,000	$455,000,000	$215,000,000
Adjustments by transfers	−84,575,214	−161,850,000	
Advances and reimbursements from other accounts	1,997,000		
Comparative transfers to other accounts	−238,161,744	−113,246,256	
Unobligated balance brought forward	67,583,806	112,145,560	39,795,560
Unobligated balance transferred (net)	170,000	−4,000,000	
Unobligated balance carried forward	−112,145,560	−39,795,560	−39,795,560
Total obligations	154,868,288	248,253,744	215,000,000

This appropriation provides research and development funds for projects assigned to the Advanced Research Projects Agency. ARPA funds for fiscal year 1961 will support research on ballistic missile defense, solid propellent chemistry, basic research on materials, and research necessary to better understand problems associated with the moratorium on nuclear testing. In addition, the funds will provide for military application of space technology techniques to navigation and communications, and will support related satellite tracking and data acquisition efforts. Work in other areas may also be assigned to ARPA.

PURPOSE AND SCOPE OF THE APPROPRIATION

The current research and development projects of the Advanced Research Projects Agency are concerned with the application of space technology to military problems, with the investigation of improved methods of defense against ballistic missiles, propellent chemistry, and materials research. Work may also be assigned to the Agency in other areas.

1. *Military science.*—Projects include missile defense, propellent chemistry, materials research, and Vela.

2. *Military astronautics and related equipment.*—Projects include military uses of satellites for communications, navigation, and tracking and data readout systems.

3. *Programwide management.*—Executive and technical management at ARPA headquarters.

Summary of program by category

	Estimated obligations	
	Fiscal year 1960	Fiscal year 1961
Military sciences:		
1. Ballistic missile defense	$106,000,000	$110,000,000
2. Solid propellent chemistry	18,000,000	17,000,000
3. Materials	240,000	17,000,000
4. Vela	8,100,000	----------
Subtotal	132,340,000	144,000,000
Astronautics and related equipment:		
1. Communications	46,000,000	42,000,000
2. Navigation	19,000,000	7,000,000
3. Tracking	17,570,000	18,000,000
4. Miscellaneous projects	29,343,744	----------
Subtotal	111,913,744	67,000,000
Programwide management and support	4,000,000	4,000,000
Total	248,253,744	215,000,000

EXPLANATION OF ESTIMATES—FISCAL YEAR 1961

Introduction

The programs of the Advanced Research Projects Agency are summarized in the following categories:

Military sciences.—Ballistic missile defense; solid propellent chemistry; materials; Vela.

Astronautics and related equipment.—Military space technology.

Programwide management and support.—Executive and technical direction.

These technical programs have been assigned to ARPA by the Secretary of Defense. Budget estimates have been developed to meet necessary national defense goals in these areas.

Program authority

The Advanced Research Projects Agency was established on February 7, 1958, by Department of Defense Directive 5105.15. This directive provides that "The Agency shall be responsible for the direction or performance of such advanced projects in the field of research and development as the Secretary of Defense shall, from time to time, designate by individual project or by category."

That certain research areas would be given special consideration was essentially endorsed by Congress in section 7, Public Law 85–325, dated February 12, 1958. This legislation, as amended by the Department of Defense Reorganization Act of 1958, provides "The Secretary of Defense or his designee is authorized to engage in such advanced projects essential to the Defense Department's responsibilities in the field of basic and applied research and development which pertain to weapon systems and military requirements as the Secretary of Defense may determine."

The National Aeronautics and Space Act of 1958 provides, in part, "that activities peculiar to, or primarily associated with the development of weapons systems, military operations, or the defense of the United States (including the research and development necessary to make effective provision for the defense of the United States) shall be the responsibility of and shall be directed by, the Department of Defense. * * *"

ARPA operations

ARPA was established as a line agency within the Department of Defense, with the Director responsible to the Secretary of Defense. In late 1959, a realinement was effected under which the Director of ARPA is now responsible to the Director, Defense Research and Engineering.

Within program areas assigned by the Director, Defense Research and Engineering, ARPA plans, initiates, and directs specific research and development projects. Although authorized by law to do so, ARPA has not built laboratories or facilities of its own. It operates as a small management team

which maintains cognizance over its assigned programs by means of budgetary control, management surveillance and technical direction. Assistance in technical matters is provided by the Institute for Defense Analyses. This group, under contract to ARPA, recommends technical projects and is available for consultation on the technical aspects of ARPA programs.

During 1959, decisions were made to transfer from ARPA's cognizance a number of military space technology projects. Discoverer, Samos, and Midas have been transferred to the Air Force. The Saturn project will be transferred to the National Aeronautics and Space Administration upon congressional approval of the "Saturn team's" transfer to NASA. In the interim, close coordination in the technical aspects of Saturn has been effected by the ARPA and NASA staffs.

Ballistic missile defense, Project Defender:

Fiscal year 1960	$106,000,000
Fiscal year 1961	110,000,000

To meet the threat of enemy operational ballistic missiles, this country must have active ballistic missile defense systems. Within the conventional concepts of active defense, the development of the NIKE-ZEUS system of terminal defense has brought us to the practicable limit of our technical sophistication. The enemy threat, however, is of such a nature that conventional concepts are totally inadequate to cope with it.

The development of advanced active ballistic missile defense systems is one of the most vital considerations facing this country. It also presents one of the most challenging technical problems with which our scientists and engineers must contend. The basic features of the problem are that missiles and reentry warheads:

Have extremely high velocity—allowing very short reaction times;
Are compact and smooth—making detection difficult; and
Are extremely durable—making destruction difficult.

To develop techniques for valid, reliable detection and identification of enemy ballistic missiles, further advances must be made in our knowledge of radar, infrared, and optical systems. The development of these techniques will be enhanced by our attaining a better understanding of both the natural and disturbed conditions of the upper atmosphere and the space medium.

The alternative methods of missile interception, i.e., early, midcourse, and terminal intercept, must be studied and carefully evaluated in their relation to the other aspects of the system. Techniques for destroying the intercepted missile or reentry warhead are being examined and evaluated. These "kill mechanisms" must be highly effective in order to destroy a missile nose cone which is capable of surviving reentry into the atmosphere.

An integral part of the defense system is a capability to receive and process the voluminous amounts of data gathered by the system's sensing elements. These data must be analyzed and communicated at ultra high speeds, with no margin for error.

The goal of the ARPA ballistic missile defense program is to provide the country with advanced ballistic missile defense systems which are technically, operationally, and economically feasible. These, together with our deterent capability and our means of passive defense, will improve immeasurably the country's defense posture.

Defender, exploratory investigations:

Fiscal year 1960	$11,000,000
Fiscal year 1961	11,000,000

The objective of this program is, through analysis and experimentation, to investigate new possible defense system concepts, new techniques and basic information which will provide the urgently needed answers to missile defense problems and lead to the design of a defensive system which will be effective against a broad spectrum of missile threats.

Ballistic missile technology currently provides the offense with significant advantage. Thus, new and novel methods of defense against ballistic missiles must be evolved continuously if they are to be effective.

The fiscal year 1961 program continues the quest for new defense system concepts, techniques, and basic information. The program is broken down into two broad areas. Defense complex studies include work on the nature and influence of the missile threat variables, evaluation of mixed system cost effectiveness,

strategic threat studies, and war gaming studies. It also is designed to promote information exchange between workers in the various fields related to ballistic missile defense as a means of stimulating cross fertilization of ideas. Related subsystem studies and development are also conducted.

Defender—Physics:

Fiscal year 1960	$10,000,000
Fiscal year 1961	10,000,000

It is believed that a better knowledge of atmospheric physics might assist in designing techniques for improved detection, discrimination, and kill of ballistic missiles at various points along their trajectory. Other fields of study include rocket exhaust physics, the physics of reentry phenomena, and physics of high altitude chemical releases.

All phases of ballistic missile defense take place within an atmospheric medium as measurable densities of atmospheric constituents extend into interplanetary space. Research in this major unknown area of missile defense, as well as in the interactions between the atmosphere and solid bodies traveling at high velocities, requires continued and expanded effort since the nature of even the undisturbed atmosphere is poorly understood.

The work underway in this field ranges from basic physics studies of atomic cross sections and molecular interactions to probable launchings, and the use of a special ionospheric radar to study electron density. The release of chemicals at high altitudes and study of artificial electron clouds and luminescence will also provide basic data useful to better understanding the medium in which weapons systems must operate.

During the past year, work on radar blackout has resulted in a decision to increase radar frequencies for terminal units, and work on reentry phenomena has indicated possible techniques of discrimination.

Defender—Data processing:

Fiscal year 1960	$2,000,000
Fiscal year 1961	2,000,000

This deals in general with research relating to the data network required for coordination of the defenses against ballistic missiles, the doctrines of target evaluation and weapon assignment, the place of the human in an automatic missile defense system, and to the study of general data processing techniques aimed at the discrimination problem.

Immediate and long-term missile defense system effectiveness will be dependent upon vast quantities of information gathered by diverse sensing elements in the missile defense complex. Voluminous amounts of data must be handled at ultrahigh speeds with unerring accuracy and efficiency. Results of the analysis of the data from the input sensing devices must be communicated to a target evaluation and weapon assignment center. These will provide the input information for launching of the interceptor with or without human intervention.

Work is underway to define, in engineering terms, the types of network problems that must be solved, and to develop computer techniques of weapons assignment as related to the decoy and discrimination problem.

The work accomplished under this program includes: The development of concepts for processing multistatic radar information; development of small, high capacity processing techniques using acoustic distortion to modulate light beams in refractive media; development of extremely high capacity, high-speed storage devices.

Defender—Discrimination:

Fiscal year 1960	$4,000,000
Fiscal year 1961	4,000,000

Conventional defense systems, i.e., those employing radar and antimissile missiles, can be built to give a high probability of kill if the attack consists, within their zone of action, of a small number of identified warhead-containing reentry bodies. However, ballistic missiles deliver payload or tonnage which can be divided in a variety of ways. If the defense system is anticipated to be highly effective against a simple form of attack, the offense can trade yield for countermeasures, such as decoys and jammers, to take advantage of the natural weaknesses of defense systems and reduce the defense effectiveness. The offense's purpose, of course, is to maximize the yield (or desired effect) on target, either by saturating, confusing, or avoiding the defense system.

It is the objective of the discrimination program to perform research which will lead to the successful attainment of a counter-countermeasure capability. To this end, it is necessary to gather pertinent data on warhead and decoy characteristics and to investigate a wide spectrum of potential discrimination techniques.

In view of the potential versatility of the threat, a prime objective of defense design is to make the ballistic-missile attack in strategic war as expensive and uncertain as possible at the least cost to the defense.

Research leading to a capability to discriminate between warhead and decoys will be continued during fiscal year 1961.

Accomplishments under the discrimination program include the development of a better understanding of capabilities and limitations of various discrimination techniques. This has resulted in the discontinuance of some techniques and the placing of increasing emphasis on others.

Defender—Interception:

Fiscal year 1960	$2,000,000
Fiscal year 1961	2,000,000

The interception program is concerned with advanced experimental and theoretical techniques to be utilized in the design of hypersonic vehicles capable of intercepting ballistic missiles or satellites at long range outside the atmosphere.

The interception task is concerned with all design and development problem areas pertaining directly to the interceptor vehicle from the time it is launched from its platform, whether ground based, airborne, or space based, until it successfully delivers its payload to the vicinity of the offensive weapon.

The primary accomplishment in fiscal year 1959 in the field of aerodynamics was the design and initiation of construction of a hypersonic tunnel which is critically needed for duplicating actual flight conditions.

In the propulson field, a low-inertia means of varying the thrust vector for highly maneuverable exoatmospheric interception will be required.

General studies of guidance and control features will be continued in fiscal year 1961.

Defender—Kill mechanisms:

Fiscal year 1960	$6,000,000
Fiscal year 1961	9,000,000

A ballistic-missile nose cone capable of surviving reentry into the atmosphere is difficult to destroy by the means now at our disposal. The objective of this portion of the program is to support a vigorous research effort designed to define more closely the kill capabilities of the mechanisms now relied on for destruction and to discover techniques of greater effectiveness. Satellites, because of the instrumentation required to carry out their function, may be susceptible to kill by means that will be ineffective against ballistic-missile warheads. These special weaknesses must be investigated.

Once the object to be destroyed has been identified, its destruction may still constitute a serious problem. Because it may reenter the atmosphere and because it generally needs no wings nor similar weak structure, the warhead reentry body of a ballistic missiles is extremely durable and can be destroyed only by extreme measures. Satellites are not likely to be quite so durable unless they are designated for reentry. On the other hand, the interception of satellites presents other difficulties such as their greater height.

This program will continue to support research designed to define the kill potential of existing kill mechanisms. The major emphasis, however, will be on investigating, analyzing, and devising new methods of destroying ballistic missiles.

Defender—Missile range measurements:

Fiscal year 1960	$46,000,000
Fiscal year 1961	57,000,000

There are many physical phenomena associated with missile launch, flight, and reentry such as visual radiation, infrared and ionization that are not well enough understood or measured to permit prediction from present knowledge, nor can they be adequately simulated in the laboratory for experimental purposes. It is necessary to go to the site of the missile test programs to get actual flight measurements. This program of range instrumentation is now in being at the Atlantic Missile Range, and other instrumentation is being procured for use on the Pacific Missile Range.

Current instrumentation covers the optical, infrared, and radar frequencies at the Atlantic Missile Range. The instruments are shipborne on the *Acania* and *American Mariner*, airborne infrared is used, and ground-based data are supplied by many sources.

A radar installation is being planned for Kwajalein to take advantage of flights in the Pacific. The radars to be installed in the Pacific will emphasize the collection of midcourse data and, together with the Atlantic Missile Range information, when analyzed, may provide keys to solving the detection, discrimination, tracking, and intercept problems. The increase in 1961 is for installation of the Kwajalein equipment and its operation.

Defender-radar:

Fiscal year 1960	$25,000,000
Fiscal year 1961	15,000,000

The radar program objective is to conduct a vigorous research program to advance the state of the art in the radar components and subsystems necessary to develop long-range high capacity, high resolution radars that are significantly beyond the capability of those that exist today. Construction of radars of this type will provide radar technique development as well as instrumentation for ballistic missile measurements in the upper atmosphere and for experiments of identification and discrimination.

Considerable improvement is required in the tools by which targets are acquired and tracked. In order to reach out as far as possible into the midcourse flight of a ballistic missile, much greater range capability, higher resolution and capacity for handling enormous amounts of data are needed. It should be emphasized that, although expensive, radars are the only currently available, well understood tool that probably will be used in a sophisticated ground based defensive system. Limited range and resolution are the major shortcomings.

The program for advancing radar technology encompasses development of more powerful equipment for range measurement purposes and technique demonstration, applied research in new radar implementation methods, and both basic research and exploratory development on components for ballistic missile defense radars. A large radar is being developed in 1960, and the decrease in 1961 reflects the nonrecurrence of this item.

In the radar program these significant accomplishments have been attained: Initiation of development of high frequency multiple-beam redar (Pincushion); continuation of development of a multielement, electronically scanned radar (esar); continuation of multistatic redar development (ordir); initiation of development of a superpower microwave tube; continuation of research in high power components, radar receiving techniques, signal processing techniques and others.

Solid propellant chemistry:

Fiscal year 1960	$18,000,000
Fiscal year 1961	17,000,000

Solid propellants have been developed intensively for military applications because of their instant readiness and reliability. Propellants now in use are at least one-third more powerful than those used 15 years ago. However, this development has been based largely on existing chemical and explosives technology, and has gone almost as far as it can. It appears that a further large improvement will require a new chemical breakthrough. The aim of the ARPA project is to provide this breakthrough. The goal is a solid propellant with at least 10 percent higher specific impulse than any now under development.

Two-thirds of the program funds are directed to the synthesis of new, potentially powerful materials which have never been made before, and testing them in small-scale engines. More than 20 laboratories are engaged in this work. Important advances have been made in the first year of the program, particularly in the synthesis of promising new compounds of fluorine. It is anticipated that by calendar year 1961 some of the more promising research programs can provide sufficient quantities for intensive propellant development and small-scale motor firing tests.

The remaining one-third of the program funds is in supporting research involving about 30 laboratories. This supporting work is necessary for the efficient development and the effective utilization of the new chemicals as they become available.

Materials research:

Fiscal year 1960	$240,000
Fiscal year 1961	17,000,000

The objective of the materials program is to strengthen substantially U.S. basic research in the field of materials.

The chemical and physical properties of materials now in use constitute major limiting factors in the performance of most weapons systems of importance to the Department of Defense. Currently, materials research is being carried out on an emergency basis as an adjunct to weapons systems development. The overall effectiveness of the Department of Defense research and development program should improve as the results of this basic materials program become available.

The evolution of new weapons systems invariably creates requirements for new, improved or unusual materials to function in severe operating environments. The solution to these complex materials problems is seldom discovered through the efforts of a single scientific discipline, but is often provided through the joint efforts of a team embracing several scientific disciplines. This materials program will foster the team approach, in the most favorable surroundings, through the support of interdisciplinary laboratories for basic research in materials at selected universities. The principal scientific disciplines which will be brought to bear on the materials problem through these laboratories are solid state physics, inorganic chemistry, high-temperature chemistry, metallurgy, metallurgical engineering, and ceramic engineering.

It is planned that this will be a continuing program, having a future annual level about the same as requested for 1961.

Vela:

Fiscal year 1960	$8,100,000
Fiscal year 1961	0

This project consists of the research and development necessary to better understand problems associated with the moratorium on nuclear testing.

Communication satellites:

Fiscal year 1960	$46,000,000
Fiscal year 1961	42,000,000

This project has the objective of providing an assessment of the technical feasibility of reliable communications satellites for use in global command, control, and support of military forces.

At the present time, military long-range communications are primarily handled by radio and cable. Cable communications are very reliable but are of limited capacity and require a long time to install. Furthermore, they are susceptible to sabotage or destruction during wartime. The reliability of current radio communications is very limited. Satellites appear to provide large capacity, secure, and highly reliable communications systems.

There are two major types of satellite communications systems, active relays, and passive relays. Active satellite systems are those capable of receiving and relaying signals by means of radio equipment within the satellite. Passive relay systems are basically reflectors which are in orbit. To meet military requirements, the ARPA projects concentrate upon active satellites rather than on passive ones.

Within the field, three projects using active relay communications satellites are being pursued:

(1) Project COURIER, a delayed, active repeater system;

(2) Project STEER, an instantaneous, active repeater for ground-to-air communication with aircraft in the polar regions;

(3) Project DECREE, a 24-hour synchronous, real-time, global system.

(1) The concept of the delayed repeater, Project COURIER, is to place within a satellite a number of receivers and transmitters with associated tape recorders. As the satellite passes in orbit over a ground station, it is commanded by the ground station to receive a message being transmitted to it. The message is then stored on the tape recorder within the satellite. At the next ground station, the satellite is interrogated by the ground station and the transmitter in the satellite, upon command, transmits the stored message which it had picked up from the previous location.

This program consists of a series of three launches each with a backup, scheduled 1 year apart. The first launching is scheduled for the second quarter

of calendar year 1960. Design of the COURIER satellite has been completed and construction of the first model is underway for scheduled completion in February 1960. The ground equipment is under construction and will be installed and tested prior to the scheduled launch date.

(2) The second active relay communications satellite project, Project STEER, has the objective of placing a communications package in polar orbit at 5,600 miles altitude, with ground stations in the continental United States and aircraft instrumented to receive and transmit through the satellite.

A system of five or six satellites in this polar orbit, properly spaced, could give complete coverage of the Arctic regions from the continental United States. This would enable a message to be beamed by means of a large tracking antenna to the satellite, which would receive it and rebroadcast it to aircraft operating in the polar regions. The aircraft would be able to reply by way of the same route.

Contracts were let during fiscal year 1960 for both the satellite vehicle and the communications payload and ground aircraft equipment. Initial launching is scheduled for the second quarter of calendar year 1961.

(3) Project DECREE provides for the placement of a real-time radio communications relay in a satellite in a 19,000 nautical mile or so-called 24-hour orbit. Satellites in this orbit will remain approximately stationary over one point of the earth. A system of three such satellites over the equator would provide complete global coverage between the Arctic and Antarctic Circles, or from approximately 75° North latitude to 75° South latitude.

Contracts have been placed with component manufacturers for preliminary studies on reliability of electronic components and for antijamming problems associated with this communication system. A system specification has been completed and system parameters have been fixed. A preliminary development system specification has been prepared and contracts will be placed soon for the high-powered electronic components and ground electronics required for this system.

In parallel with the real-time active communications satellite projects, a general study of communications satellite concepts will be continued. New research effort and design work will be started on high reliability long-life satellite components, solid-state devices for use at microwave frequencies and applications of molecular electronics techniques. Research studies will be conducted on optimum band utilization, antijamming, and long-life kilomegacycle tubes.

Precision navigation satellites:

Fiscal year 1960	$19,000,000
Fiscal year 1961	7,000,000

The objective of the precision navigation satellite program (Transit) is to improve for ships and aircraft the present capability for navigation with regard to: (*a*) the precision of navigation, (*b*) worldwide coverage, (*c*) simplicity of mobile navigating equipment, and (*d*) all-weather capability.

Many critical military operations demand more exact knowledge of location or position than it is possible with current navigation systems. Satellites, by virtue of the stability and predictability of their orbits, indicate great promise as precise global all-weather aids to navigation. By using a radio transmitter at a precisely controlled frequency, they emit a signal by which observing stations (ships, submarines, or aircraft) can determine position to an accuracy of a fraction of a mile.

Under this program, which has been in progress since early fiscal year 1959, one satellite launch attempt was made in September 1959. Although orbit was not achieved, data obtained prior to re-entry of the payload confirmed the usefulness of the system. The program for the balance of fiscal year 1960 and fiscal year 1961 contemplates continuation of the development and test including three launchings of Transit payloads.

Satellite tracking and data acquisition:

Fiscal year 1960	$17,570,000
Fiscal year 1961	18,000,000

The objectives of the ARPA space surveillance program are as follows:

(*a*) To detect rapidly, track, collect data from, and assess unknown, silent or uncooperative satellites and to maintain a catalog of all satellites so that new objects in space are immediately identifiable as such.

(*b*) To support the military scientific and development program in space by providing tracking information, data reception, communications and command facilities for both manned and unmanned satellites and to provide tracking data reduction on all known and cooperative satellites.

(*c*) To provide support of the nonmilitary space program of NASA reciprocally with NASA's support of the military program in accordance with DOD commitments to NASA.

Both the Department of Defense and the NASA have a need, implicit in every space program (1) of knowing precisely where satellites and space probes are at any moment, to relate this information to the data the satellite is receiving, and (2) of receiving this data on the ground for analysis and use. The worldwide nature of this undertaking, as well as the peculiar requirements of specific projects, requires an extensive investment in stations and equipment and has resulted in a cooperative effort by DOD and NASA to provide a mutually supporting system.

During fiscal year 1961, the Advanced Research Projects Agency plans to fund three major programs for space surveillance. These are continuing programs which are in an advanced stage of development and are partially operative in an interim sense. The first of these is the Spasur project, for the purpose of continuing the east-west satellite detection fence. The second is project Spacetrack. This project has the objective of receiving and analyzing the orbital data that is received from the fence and other sources, such as the NASA minitrack network, the military missile ranges, etc., and making this digested and collated information available to interested agencies of the Department of Defense, NASA, and nongovernmental agencies where appropriate. The third project is for installation of tracking and data collecting devices overseas. In addition, studies of future possible approaches to space surveillance systems, and research and development in the fields of advanced detection, tracking, and data collection devices are planned.

Miscellaneous projects:

Fiscal year 1960	$29,343,744
Fiscal year 1961	0

The obligations shown above will be incurred on projects which will be completed in fiscal year 1960, or are the residual obligations of projects transferred to other agencies during 1959 and 1960 and not shown as comparative transfers in the schedules. Included are projects such as Meteorology and Centaur (transferred to NASA) and space technology feasibility studies (transferred to NASA, Air Force, and Navy).

Programwide management and support:

Fiscal year 1960	$4,000,000
Fiscal year 1961	4,000,000

The Advanced Research Projects Agency is responsible for the planning, development, administration, and management of the various advanced research projects as assigned by the Director, Defense Research and Engineering. In the execution of its program, extensive use is made of existing facilities and services of the military departments, other Government agencies, universities, and industry. Under this concept of operations, ARPA does not duplicate or add to that which already has been established and available in the way of facilities and personnel to carry out its program. Accordingly, ARPA can execute its overall technical and administrative program planning and management responsibilities with a relatively small staff. Through a contract with the Institute for Defense Analyses, ARPA is provided highly specialized scientific and technical program proposals and evaluations which are vital to the successful development, appraisal, and technical management of specific areas of advanced research, as assigned.

The funds requested provide for the salaries and other necessary expenses such as travel, communications, equipment, supplies, and professional services required in the planning, direction, and management of the program of advanced research.

Mr. MAHON. We are dealing in here with highly technical matters. Proceed as you think best, General.

General BETTS. Off the record, please, Mr. Chairman.

(Discussion off the record.)

Mr. MAHON. On the record. Proceed with your statement, General Betts.

GENERAL STATEMENT OF DIRECTOR, ADVANCED RESEARCH PROJECTS AGENCY

General BETTS. Mr. Chairman and members of the committee, I appreciate the opportunity to appear before you and explain the ARPA fiscal year 1961 budget request.

Dr. York reviewed for you in his opening statement on the fiscal year 1961 R.D.T. & E. budget, the recent changes in the role to be filled by ARPA in the Defense Department's overall research and development program. Consequently, many projects in the fields of space science and technology which were formerly under the cognizance of ARPA have been, or are in the process of being, transferred to the Departments of the Army, Navy, and Air Force, or to the National Aeronautics and Space Administration.

The funds requested for those advanced research projects currently assigned to ARPA total $215 million for fiscal year 1961. The projects and recommended funding are as follows: Ballistic missile defense, $110 million; solid propellant chemistry, $17 million; materials research, $17 million; communications satellites, $42 million; navigation satellite, $7 million; tracking, $18 million; and executive and technical direction, which covers the management costs of the program, $4 million.

About one-half of the ARPA budget is devoted to ballistic missile defense research. Under this project we are attempting to develop adequate means to counter an operational ballistic missile attack in the future. The objective of this project is to obtain an advanced system of defense either supplementary to or extending beyond the present NIKE-ZEUS terminal intercept concept.

The missile-defense research effort follows many courses. First of all, we are attempting to acquire an understanding of the behavior of missiles, their characteristics, and the environments in which they will operate. This is being accomplished through a range measurements and upper atmospheric physics research program. Data is acquired from missiles in flight during the various phases of their trajectory for study and analysis. Furthermore, ARPA is undertaking research to define, develop, and devise advanced methods of detecting the missile at the time of launch, identifying and tracking the missile throughout its flight, discriminating between the warhead and possible decoys, intercepting the warhead, and destroying the warhead. In addition to these elements of ballistic missile defense research, we are supporting some "blue sky" research efforts of the "high risk, high gain" variety which may ultimately be the source of significant advances in our knowledge of relevant technology.

Our objective in propellant chemistry research is the discovery and development of new chemical combinations providing at least 10 percent more usable energy than the best propellants under development today. Our research in this field is directed toward (1) the synthesis of new propellant combinations which have never been attempted or achieved before and, (2) the accomplishment of related

supporting research required to utilize the new propellants effectively as they become available.

ARPA's newest program is materials research. The objective here is to augment the national program in basic research in the field of materials through the establishment of interdisciplinary laboratories at selected universities. The deficiencies of materials available today constitute major limiting factors in the development and performance of advanced military systems. Many of these deficiencies are directly attributable to the fact that applied research in the field of materials has expanded considerably without a corresponding increase in the underlying basic research which is so vital in overcoming materials problems. In order to make the necessary academic commitments now and thus avoid losing a year in starting this important program, it is being initiated through a reprograming of fiscal year 1960 funds. A notice to this effect was filed with the committee a short time ago.

Vela is a major project recently assigned to ARPA. It relates to the problem of detection of nuclear explosions. It was assigned to ARPA after the fiscal year 1961 budget determinations were completed; consequently, funds to continue the research in fiscal year 1961 are not contained in the budget submission.

In addition to these primary assignments, ARPA has retained responsibility for certain military space satellite projects until such time as they are transferred to a military department. These include communications, navigation, and tracking.

The communications satellite program is an effort to assess the technical feasibility of reliable, efficient, and relatively secure global communications employing earth satellites. The navigation project is designed to develop a satellite system to provide a more precise, worldwide, all-weather navigation capability.

The tracking and data acquisition project is based on the military need to know precisely where all satellites are at any given time. To this end, ARPA is developing a satellite detection fence, providing for supplemental receiving antennas, and developing a national space surveillance and control center to catalog and disseminate all information received from satellites.

I have with me Mr. William Godel, Mr. Wilbur Bolton, and Colonel Dent Lay of the ARPA staff.

This concludes my opening statement.

I shall be happy to explain ARPA's program further in executive session.

Mr. MAHON. Now, General, proceed with your classified statement. Of course, you will delete the classified portions when you review the record.

General BETTS. Thank you, Mr. Chairman.

It is a privilege to be able to come over and give you the ARPA program because I think we have a very important exploratory research effort, in which I am sure you are interested.

I have brought viewgraphs along and have a rather long presentation, which will run about 45 minutes uninterrupted. Of course, I am prepared to be interrupted any time you wish.

Mr. SIKES. You have been coming up here a long time, General, and you do a very good job as a witness.

Mr. FORD. He formerly came before the Army panel and was a very good witness at that time.

Mr. MAHON. We are always pleased to have good witnesses and you have always done credit to your assignment when you have been before us.

General BETTS. The research and development programs for which ARPA has cognizance are defense against ballistic missiles, solid propellent chemistry, materials, detection of nuclear explosions at high altitudes and underground, and military application of space technology techniques to communications, navigation, and tracking of satellites.

The ARPA program and related budget estimates for fiscal year 1961 total $215 million which compares with an adjusted fiscal year 1960 base of $248.3 million. The decrease results from projects which will be completed or transferred from ARPA to other agencies in fiscal year 1960.

A program breakdown of our fiscal year 1961 budget requirements is presented on this vuegraph. Ballistic missile defense, $110 million; solid propellent chemistry, $17 million; materials, $17 million; communications, $42 million; navigation, $7 million; tracking, $18 million; and executive and technical direction, $4 million. The latter provides for such items as the administrative cost of the program, technical evaluations capability obtained under contract with the Institute for Defense Analyses, and provision for summer study groups to make conceptual analyses of basic technical problems affecting the national defense, which we call Project Sunrise.

With regard to the project for detection of nuclear explosions, it was assigned ARPA after the fiscal year 1961 budget determinations were completed. Consequently, funds to continue the program in fiscal year 1961 are not contained in ARPA's budget submission.

I shall now discuss each ARPA project.

No sooner had this country achieved a relatively effective defense against an enemy air attack, than we found ourselves and our allies faced with a new military threat: The operational intercontinental, intermediate range, and submarine launched ballistic missiles. We know today that there are in being intercontinental ballistic missiles which can reach, with requisite accuracy, any population center or strategic location in the United States from a distance of over 7,000 miles within approximately 37 minutes after they are launched. This period of time is even shorter for submarine launched missiles. However, we do not have today, and it is not apparent that we will have within a period of many years, any defense against this new threat. ARPA therefore considers the ballistic missile defense project its most important assignment and the most urgent defense problem facing the country.

The fact that there is no defense against the ballistic missile today is a measure of the difficulty of the problem. The development of a missile defense system defies all conventional concepts of active defense and, accordingly, presents to the scientist and engineer one of the greatest technical challenges in this era.

A ballistic missile offensive system can be extremely complex and capable of innumerable variations. The compactness and smoothness of the reentry body make detection very difficult. Decoys, which

can be mistaken for the warhead, can be carried which will enable the enemy to confuse our detection systems. The extremely high velocity of an ICBM allows an incredibly short reaction time. But, even if we can detect the missile in sufficient time, there is still the problem of discrimination in order to identify the warhead from among the many possible decoys in threatening trajectories. Then, of course, missiles can carry multiple warheads which might follow dispersed trajectories, or it is even possible that their courses could be altered. And finally, there still remains the problem of "killing" the warhead.

ARPA's task is to advance the many areas of technology involved in solving these problems, but you must realize that before any defense can be developed to counter all the peculiarities and characteristics of this threat, one must first of all show it to be technically feasible. It must be shown to promise adequate effectiveness in dealing with the assumed threat. Moreover, one must be convinced that the proposed defensive system will be able to cope operationally with all the complexities of logistics and communications, as well as human factors. Third, the factor of cost effectiveness must be considered. There are many choices that will probably be proposed for a missile defense system, but the cost relationship to total effectiveness may be exceedingly high. Therefore, the ultimate system to be developed must represent an optimum among all possible choices. Then, of course, an overridding consideration is that of achieving this "optimum" system at the very earliest date.

What is being done about this, looking beyond the expected capabilities of the early NIKE-ZEUS system? In a period of a little more than 18 months since being assigned the project, a concentrated and vigorous research effort has been inaugurated, which we call DEFENDER. This country's leading scientific and technical resources have been brought to bear on the matter. Approximately 150 contracts with private industry, universities, research institutions, and Government laboratories are currently in effect representing a dollar volume in excess of $100 million. The program is carefully designed to complement the ballistic missile early warning system (BMEWS) and the NIKE-ZEUS system assigned to military departments for development. In addition, ARPA's program also includes research on means of defense against military satellites which might be employed by the enemy.

Basic to the problem of missile defense is the need to acquire an understanding of all ramifications of missile defense, missile characteristics, and their operating environments. To this end, one of our largest research efforts is a missile range measurements program. This program is designed to observe and study ballistic missiles in their actual environment during launch, midcourse flight, and reentry into the atmosphere. Data are gathered on such physical phenomena as electromagnetic emissions, ultraviolet, visible light, infrared and microwave radiations, and from the wave and trails resulting from the missile. Understanding both the natural and disturbed conditions of the upper atmosphere and the space beyond may unlock the answers to many of the unknowns so vital to the establishment of an effective system of defense.

Funds for the program are primarily associated with the acquisition and operation of extremely complex and intricate instrumentation and facilities.

Measurements of data are made from the sea, air, and land. On the Atlantic Missile Range observations of missiles launched from Cape Canaveral are made from a converted liberty ship, the *American Mariner*, and from aboard the motor yacht, *Acania*. Both vessels are equipped with several radar and other measuring devices for gathering data throughout the spectrum of a missile's flight.

Airborne observations for high altitude inspection of the powered flight and reentry phase of missiles on the Atlantic Missile Range are made from specially instrumented KC–135 and C–130 aircraft.

To supplement the aircraft measurements, we are providing instrumentation for use on IRBM and ICBM vehicles to obtain background data and rocket plume and nose cone measurements.

Ground-based optical, acoustical, and electromagnetic observations are now made on the Atlantic Missile Range. ARPA is also planning to initiate a rather extensive ground based measurements program on the Pacific Missile Range. Two radars called Tradex and Pincushion, and other sensors along with computational equipment to provide for real-time data processing, will be installed on the Pacific Missile Range. The location of this $75 million installation was dictated by the NIKE-ZEUS test firings against ballistic missiles which will occur in this area of the Pacific. The location will also permit observations of training missiles launched from the Vandenberg and Point Arguello sites.

In addition to acquiring range measurement data from this radar-computer complex, it will also be used as a research tool to improve radars with enhanced capability to discriminate between missile warheads and decoys, and increase radar power and range. Another and more immediate value of the facility is its use to collect data from NIKE-ZEUS test firings in order to evaluate and improve the capabilities of the NIKE-ZEUS concept of terminal intercept.

The range measurements program is supplemented by analytical and laboratory investigations through our atmospheric physics program. After the observations of phenomena are made from actual missile flights, an extensive laboratory and theoretical program must be undertaken to permit interpretations of the range data under controlled conditions and to extrapolate the data for various mediums. Additional studies beyond those now being carried out are concerned with atomic cross sections, changing molecular relationships, electron densities, and other atmospheric constituents. Results from the Argus test conducted by ARPA over a year ago require further examination to determine the effects of nuclear bursts in the upper atmosphere: ———. Parts of this essential laboratory program will be carried out jointly with the Canadians at their Canadian Armament Research and Development Establishment.

A very real stumbling block in our capability to find new techniques for ballistic missile defense is our ignorance of the detailed nature of the very thin, high altitude atmospheric medium where midcourse flight occurs. To acquire data on electron distribution small regions of the ionosphere out to one earth radius and beyond must be probed continuously. One of the means by which such data will be obtained

is a 1,000-foot-diameter radio frequency sounder. Installation of the device in a natural bowl in Puerto Rico will begin in fiscal year 1961. This research tool will be available to other interested agencies since it has general scientific applications as well as military use.

After providing for the examination and study of the characteristics of the missile and its operating environment, our research effort is structured on the basis of the expected operational sequence of a missile defense system. For example, once a missile is launched it must be detected, then identified through discrimination from decoys to determine the warhead, and finally, the warhead must be intercepted and killed. Let me explain our research efforts which contribute to each of these functions.

The initial function of any missile defense system is to detect that missiles have been launched and to determine their trajectories. From research efforts to date, it appears that radars are the most effective tool which can be used for this purpose, although other means of detection are being explored. With regard to today's radars, they are limited in power, range, resolution, and capacity.

In an attempt to resolve these limitations, several novel radar concepts are being examined. One is the so-called Pincushion radar which will be a powerful tool for observing missile phenomena in extra atmospheric as well as terminal phases of the missile trajectory.

Mr. FLOOD. What do you mean by "terminal phases?"

General BETTS. In the last quarter of the trajectory. In other words, as might be detected from the target itself.

Mr. FLOOD. At both ends or just one end?

General BETTS. At the receiving end. This radar will be located on the Pacific Missile Range where it will be operated for research associated with measurements on test missiles from the NIKE-ZEUS program.

Another radar being developed is the ESAR, or the electronically steerable array radar. The novel feature of this, as its name implies, is the development of a radar which will be aimed at an object by electronics rather than mechanical movement as required in radars used today.

ORDIR is still another radar concept being studied.

Various aspects of advanced radar techniques aimed at improving the present state of the art are also being pursued. These include studies on new high-power tubes, R. F. sources, improved accuracy, low noise receivers, and information extraction.

Once a missile or warhead has been detected, it must be identified and discrimination between the warhead and decoys must be made. Presently known techniques will be inadequate. It is expected that an enemy using ballistic missiles can surround the missile warhead with a cloud of tank fragments or decoys to confuse the defense system. Some decoys are very simply employed.

Since interceptors are very expensive and time is so limited to employ defensive measures, it is hardly feasible to shoot at every object that might be seen on radar. Hence, the difficult problem of finding the real warhead must be accomplished at the earliest possible point along the trajectory.

Because the discrimination system will probably have to be diversified, all possible techniques are now being investigated. Warhead

and decoy characteristics are being examined. Much of the radar program I described earlier will be oriented toward discrimination capabilities. This will be particularly true of Tradex and Pincushion radar operations.

Once discrimination of the warhead has been accomplished, the warhead must be intercepted. Interceptors capable of the required hypersonic speeds, rapid maneuvers, and severe guidance and control parameters over long ranges outside the atmosphere are nonexistent today. Therefore, it is necessary to undertake an experimental and theoretical program to provide information which will be required when the performance requirements of a specific interceptor have been established. To this end the construction of a wave-super-heater hypersonic tunnel, which is critically needed for duplicating actual flight conditions, was initiated this fiscal year at Buffalo, N.Y. Upon its completion next year extensive aerodynamic studies will get underway.

The launching of an interceptor is dependent upon volumes of vital information which are acquired from detection, tracking, and identification of the warhead. All the data acquired on these functions from the various radar and other sensor equipment must be sorted, identified, and transmitted over long distances and at very high speeds so that all necessary defensive actions which might be required can be taken almost at the instant when the necessary information is received.

ARPA's data processing project supports investigations of various techniques for receiving, processing, and analyzing the anticipated large volumes of complex data.

After interception takes place, the destruction of the warhead may constitute a very serious problem.

(Discussion off the record.)

I have just outlined the various areas of ballistic missile defense research being pursued. From the information obtained from the many research efforts to date, several concepts of missile defense are developing, but all require considerable study before their feasibility can be assumed.

Perhaps a system might be achievable in the late 1960's. There are, however, many critical and complex technical, and operational, problems. These will require careful study during the next several years.

Before I leave the missile defense program, I should like to bring to your attention the fact that we are not only looking for a missile defense system to satisfy tomorrow's requirements, but we are supporting efforts of "blue-sky" research hoping for significant scientific breakthroughs to resolve problems with which we might be faced 10 to 20 years from now. One of the more important projects sponsored in this area is called GLIPAR, Guide Line Identification Program for Antimissile Research. It represents a concerted and serious attempt to identify clearly any unorthodox approaches to ballistic missile and military satellite defense which might provide very high capability in the future.

Overall, ARPA's present philosophy in missile defense is in consonance with the Department of Defense evaluation that insufficient information is available today to provide an assured basis for commitment of any active defense system to production at this time. Under this philosophy, the earliest availability of an active defense system will be several years assuming it is based on the NIKE-ZEUS termi-

nal intercept concept. If based on some concept for which the feasibility is not now reasonably well established, a system may not emerge for several years thereafter.

SOLID PROPELLANT RESEARCH

The next program is that of developing solid propellants of higher performance and greater efficiencies than available today. The advantages of instant readiness, ease of handling, weight and reliability of the solid over the present-day liquid propellant are well recognized. Nevertheless, the usable energy of solid propellants available today is not as high as is desired for military missiles and space vehicle boosters. Recent emphasis on hardware programs has exhausted the well of basic research knowledge in this area. We have almost reached the practical limits of existing chemical and explosives technology, and further significant increases in performance cannot be expected.

ARPA, therefore, in conjunction with the three military departments, embarked upon an extensive research program in 1958. Its objective is the discovery of new chemicals, the development of practical methods of synthesis, and the acquisition of knowledge to utilize the new materials in highly efficient propellants. The initial goal of our program is the development of a solid propellant with a usable energy at least 10 percent higher than the best propellant under development today. This goal may appear to be modest. However, these increases, if achieved, may permit proportionally greater missile ranges, considerably higher payloads, greater accuracies, or significant reductions in the gross weight of the missile.

Alternatively, the increase in payload capability could also be employed to provide decoys or warhead hardening or some combination thereof.

The POLARIS missile offers another example of how our research effort for higher energy is expected to pay off in terms of increased range. This could dramatically increase the flexibility of employment of this weapon system.

Projects covering areas of propellent technology and supporting research are underway in more than 50 industrial, academic and Government laboratories. It is anticipated that it may take as long as 5 or 6 years to produce the higher energy propellants for use in the advanced versions of MINUTEMAN, POLARIS and PERSHING type missiles.

Mr. MAHON. We will adjourn and reconvene at 2 o'clock.

AFTERNOON SESSION

Mr. MAHON. You will please proceed, General Betts.

MATERIALS RESEARCH

General BETTS. One of ARPA's newest programs is materials research. Materials deficiencies are a major limiting factor in the development and performance of advanced systems and devices important to the military as well as to the requirements of other Government agencies. Extremely high temperatures, pressures, and vac-

uums encountered in the space and nuclear era are unyielding obstacles to the advancement of progress. Other factors with which today's materials cannot compete are erosion, corrosion, oxidation, radiation, shock, and structural strength, to name only a few. In addition, there is the constant search for materials with improved strength to weight ratio. Much too often today's military equipment failures result because some piece of hardware did not stand up under the rigors of its intended operational environment.

Because of the importance and urgency of relieving the restrictions placed on progress by materials, the Federal Council for Science and Technology reviewed the overall materials research programs in the United States. It found that applied research in the field had been expanding rapidly over the past several years without a corresponding increase in basic research which is so necessary before fruitful advances can be expected in the improvement of materials. The Council concluded, therefore, that in order for the Federal Government to get at the root of the materials problem, basic research must be substantially increased immediately.

Studies were undertaken to determine the best method of significantly augmenting the materials basic research program. As in almost all cases, the most logical and best way to do this is through universities which are the traditional foundation for basic research in a free economy.

Accordingly, ARPA was assigned responsibility to initiate a materials research program with the primary objective of providing a significant increase in materials basic research at qualified graduate schools. Such a program, besides increasing attention to basic research in this area, promises several additional benefits. Through the support to be provided, the DOD can motivate, direct, and focus basic research programs toward its primary needs. It is our intention to establish interdisciplinary programs in basic materials research so that all pertinent scientific and engineering disciplines having impacts on materials are brought together in a single effort for a cooperative research approach. Another benefit which will accrue is an expected substantial increase in the number of suitably trained scientific and engineering personnel at the Ph. D. level, since much of the work will be done with the assistance of graduate students and postdoctoral fellows. This will help bring about a long sought after relief in the acute shortage of trained scientists and research engineers in the materials field.

Over 30 interested colleges and universities throughout the country were invited to submit proposals for the basic research program contemplated. With the help of Army, Navy, and Air Force representatives, ARPA has completed a careful screening to select the three best qualified schools. Contract negotiations will be underway shortly.

During the course of our inquiry into how basic research might be increased at the universities, ARPA found that many graduate schools already performing some materials research for the Government were seriously handicapped by the lack of suitable equipment required in this very difficult and complex research effort. On the basis of demonstrated needs, ARPA is supporting the procurement of specialized materials research equipment for some 60 universities throughout

the country. This will considerably enhance the effectiveness of the universities to perform basic research tasks on currently active Government contracts, and at the same time will also strengthen and increase basic materials research activities at these universities.

NUCLEAR DETECTION

VELA is the most recent major project assigned to ARPA. This project relates to the detection of nuclear explosions.

It is now technically feasible to explode nuclear devices deep underground and in outer space which can go undetected with present day detection equipment. In order to meet this challenge, ARPA has launched a theoretical and experimental research program which will lead to the design of a technically sound and reliable nuclear explosion detection system.

Our nuclear detection research program was begun this year with funds given ARPA by the Secretary of Defense. As I mentioned earlier, fiscal year 1961 budget determinations were made prior to the initiation of the program and, accordingly, the fiscal year 1961 funding requirements are not included in the DOD budget.

MILITARY SPACE TECHNOLOGY

In September 1959, when a decision was made to transfer from ARPA's cognizance the military space technology projects, it was decided that the communications, navigation, and satellite tracking projects would be kept within ARPA until further research had been performed to clarify their technical feasibility, and until such time as the Director of Defense Research and Engineering recommended to the Secretary of Defense their transfer to a military department. Although it is expected that these programs will have progressed sufficiently in the research phase so that transfer can take place sometime this year, the ARPA budget provides the funding of the programs through fiscal year 1961. These funds will be transferred with the project to whatever service is given responsibility.

ARPA's overall communications project is called Notus. The critical need for an adequate, reliable, secure, and disturbance-free long-range military communications system was discussed with you in some detail last year. We believe that satellites can fulfill this requirement. To this end two types of communications systems are being developed, a delayed repeater and an instantaneous type system.

The current ARPA program has two major efforts; first, a delayed repeater communications project is known as project Courier. This concept provides for placing within a satellite a number of receivers and transmitters with associated tape recorders. As the satellite passes over a ground station, a command will be given to receive a message being transmitted to it. The message is then stored on a tape recorder in the satellite. At the next ground station the satellite, upon command, transmits the stored message picked up at the previous ground station. The satellite will weigh about 500 pounds. One satellite will have a capacity equivalent to 20 teletype channels of 100 words per minute. An experimental stationary ground station is being provided at Puerto Rico and a transportable station for

use in the United States. Thor-based vehicles will be used to launch the satellite.

The second part of the program is to develop an active instantaneous satellite system. This project, as it has just been reoriented, is now termed Advent. It calls for three satellites equally spaced around the earth in a 19,000 nautical mile equatorial orbit. Satellites in this type of orbit will remain approximately stationary over one point of the earth. These satellites, along with several satellites in polar orbit to fill in the polar regions, will provide for complete global communications at all times for ground-to-ground, ground-to-ship, and ground-to-aircraft transmissions. The latter is of special importance for control of movable military equipment.

Satellite payloads are currently under development. Several series of launches of intermediate orbit tests will be required in this program before the 19,000-mile system will be attempted. Atlas boosters with Agena and Centaur second stages will be utilized to place the vehicle in orbit.

The Transit navigation satellite project is designed to demonstrate a worldwide, mobile, all-weather, interference resistant navigation system for locating submarines, ships and aircraft. This project is particularly important for providing an accurate location of the launch points for the various movable missile delivery systems being developed. In addition, the project will enable us to obtain geodetic measurements of greater accuracy than attainable through conventional methods and thus provide greatly improved navigation accuracies so essential to military systems.

The satellite will emit coded signals at precisely controlled frequencies by using a specially developed radio transmitter. The signals represent the orbit characteristics of the satellite and, when received by the observing station, can be used to determine their position.

Four satellite launches from the Atlantic missile range are programed. The first satellite launch attempt was made in September 1959. Although orbit was not attained because of failure of an upper stage of the THOR–ABLE vehicle, data obtained in the course of its limited flight before failure gave indication that the satellite navigation concept is sound. THOR-based vehicles will be used for the next three launches.

The satellite tracking and data acquisition program, project SHEPHERD, is based on a national need for developing an effective ground environment to determine where all satellites are at any given time. You will recall that this is a joint program being undertaken by DOD and NASA. The DOD sponsored program has three parts.

The first part is the development of a satellite detection fence to detect, identify, and track silent or uncooperative satellites. The fence, a modified active minitrack system, consists of a series of stations constructed across the southern United States. At the present time the fence is in interim operational use. Data received from it is being reduced and transmitted to interested agencies. It was this fence which recently detected the previously unidentified Discoverer V capsule in a polar orbit.

The second part of the program consists of supplementing existing DOD and NASA worldwide facilities by providing supplemental

receiving antennas for tracking data acquisition, and control of satellites of each agency. Location of the antennas is presently being studied. The character of this program requires an extensive investment in stations and equipment which DOD and NASA have mutually agreed to develop, support and monitor.

The third part of the program consists of developing technical specifications which will be required to establish a national space surveillance and control center, SPACETRACK. When fully developed, SPACETRACK will be a central point for data reduction, analysis, cataloguing, and dissemination of information acquired from all earth satellites and space vehicles. After the satellite data acquired has been processed by SPACETRACK, it is sent out, as needed, to all military, intelligence and scientific agencies entitled to receive it. Although R. & D. work on this filter center is still continuing, development had progressed far enough by November 1959 to permit initial operations.

This concludes my program presentation, I shall be happy to answer any questions.

Mr. MAHON. The country which first obtains a reliable defense against the ICBM, if indeed such a defense is obtainable, will gain an enormous advantage over its opponents. If the Soviet Union felt that it could defend itself against our ICBM's, it might be encouraged either to attack the United States or make threats which would place us in a difficult situation.

You have given us an excellent presentation of your efforts in developing an anti-ICBM. Do you have any knowledge of Soviet efforts in this area?

(Discussion off the record.)

MATERIALS RESEARCH PROGRAM

Mr. MAHON. Do you think wide dissemination of efforts in your materials research program will be as effective as a procedure which would concentrate on major efforts by few facilities?

General BETTS. I do not quite see why you feel we are spreading the base of our materials research program. I think the purpose of bringing ARPA into this picture is to have as uniform a control of this program as it is possible to get and yet have it responsive to the needs of the three services, without fragmenting it by putting it out to be administered by the three services. We have only three universities proposed to be supported with fiscal year 1960 funding. If the Congress and the administration go along with ARPA's proposal that we fund this at about $17 million per year, I would predict that next year we could pick up an additional three universities; the following year an additional three, and that is about where ARPA would have to end unless people wanted to raise the overall level of support for this kind of an effort, because we are contracting for larger packages than in most of the basic research support that is now being given universities.

As you are probably aware, when the services go to a university now to support research, they usually pick one or two investigators and let a contract for, let us say, some $30,000, $40,000 or $50,000, something in that order. We are talking about an interdisciplinary laboratory where we do not limit this to the department of physics,

chemistry, or the department of metallurgy. We will ask the university to pull its several departments together and to commit themselves to providing adequate facilities to do an interdisciplinary job. The level of effort in any university will probably be in the order of some $1 million a year.

There is one thing we are doing which does spread across the 60 universities we mentioned. I think this is very important. We are buying equipment and, in effect, using the grant authority which Congress has given us to give that equipment to the 60 universities. Universities are chosen which have going programs in materials research being supported by the Army, Navy, or Air Force. The universities have not been able with small increments of research support to buy the kind of equipment that they ought to have for a really modern program.

We have made a survey and we have said that this $3 million and another $3 million next year will materially improve their ability to pay off on the research that is already being supported. In effect, our program is to protect the government's investment that is already being made.

Mr. MAHON. General, I know of a college in my hometown in Texas, a technological college, a school of about 9,000 students which has technical and engineering departments. They are interested in this wide field.

I have thought at times that the Defense Department more or less selected certain universities thus giving them a vested interest and maybe you have not broadened the base to other areas and other colleges where there might be a real potential.

Do you have any feeling for that?

General BETTS. Certainly it is true that the rich get rich and the poor get children.

There is no question but what the services in looking for areas to support research go to the places where they find the most renowned investigators. That has tended to put Defense supported research, as well as that of the rest of the Government agencies, in larger universities.

I would think that to expand the effort into smaller schools would require increased effort of the Army, Navy, and Air Force across the board.

If the program in materials research were just to broaden the entire base of materials research, I would be the first to recommend that ARPA not be a part of this program, that we take the money and give it to the Army, Navy, and Air Force and tell them to follow their current procedures adding some of the other universities not now being adequately supported.

The primary goal of the ARPA program is to augment the program in such a way that we maintain a very high quality and an interdisciplinary approach. This means that the university has to have quality in the several disciplines involved and, at the same time, the program must be set up in such a way that it is not just a grant of dollars which then invites the chosen university to hire people from other universities. We want them to build in a logical way to create more Ph. D. fellowship support.

In the process, it permits DOD to get a lot more research done by good new people.

ADEQUACY OF ARPA BUDGET

Mr. MAHON. The fiscal year 1960 appropriation for ARPA was $455 million. The request for fiscal 1961 is $215 million. Although several important and costly programs have been transferred to NASA and the military services, the remaining programs under ARPA are important and several will, no doubt, require millions of dollars before the desired results are forthcoming.

Are these areas of the ARPA budget which, in your opinion, are not sufficiently funded?

FUNDING OF THE VELA PROGRAM

General BETTS. In my judgment, the $215 million proposed for fiscal year 1961 is adequate to the missions now assigned to ARPA with the exception of the VELA program. The VELA program, as I remarked, came along after fiscal year 1961 budget determinations were made. The Office of the Secretary of Defense is considering how to fund the 1961 increment of the VELA program.

Mr. MAHON. You think you might do that through the emergency fund?

General BETTS. This would be the last way to do it. We would either do it by DOD reprograming or some other way.

I do not know what the answer will be. I do know that there are several technical decisions that have to be faced before we know exactly how much the 1961 increment should be. It can range all the way from about $20 million up to $60 million.

NECESSITY OF ARPA PROGRAM

Mr. MAHON. There are those who feel that the establishment of the Director of Research and Engineering makes the ARPA program unnecessary.

What are the pros and cons of that question?

General BETTS. Well, I think that this could best be answered by referring to the Defense Reorganization Act of 1958 which gave to the Director of Defense Research and Engineering the authority to contract directly for programs, or to direct, in a technical sense, the details of certain programs which he felt ought to be directed by the Department of Defense, rather than assigning the direction to one of the several services.

He could have set up a new office to do this, but the logical thing was to take this authority, move the independent ARPA agency into his own structure, and use that as a mechanism for carrying out this responsibility.

Mr. MAHON. Is that what he is doing?

General BETTS. That is what he has done.

I look to Dr. York for my technical direction. He is my immediate superior for direction of the programs I have. My program assignments come to me signed "Dr. York." They do not come from the Secretary by direct means.

Mr. MAHON. Do you think this is a satisfactory and thoroughly workable arrangement, and do you believe that it should be continued?

General BETTS. I firmly believe in this mechanism for accomplishing certain programs. The important thing is that we must be very careful about the nature of the programs that are assigned to ARPA. For example, if as a result of the ARPA effort we demonstrate, in a real sense, the feasibility of a satellite-based ballistic missile defense system, then it would appear to me that the great American press might immediately blow this up into an ARPA-versus-services fight for the money for ballistic missile defense. Since we are, in fact, working hand in glove with the services in a very real way, I think we can ride through any such criticism of our program and keep it on a very solid, technical basis. Surely you have a great deal of familiarity with just what happens where a new idea is in one service and the going program is in another service. So, for those areas that are very highly controversial or that feed into the separate services in a very important way, I think the Secretary needs or the Director of Defense Research and Engineering needs a central mechanism to handle certain programs.

Mr. MAHON. Do you share the view generally of Dr. York with respect to NIKE-ZEUS?

General BETTS. Yes, sir; I do.

(Discussion off the record.)

NECESSITY FOR RESEARCH

General BETTS. If missile defense were not a tough problem, I could not, for a minute, justify to you $100 million a year worth of nothing but exploratory research.

Mr. SIKES. This is extremely interesting and very valuable to the committee.

Suppose that we use submarines with a 1,200-mile POLARIS missile or SAC bombers with a 500-mile HOUND DOG or the SKYBOLT, or that the enemy uses submarines with a 500-mile or 1,000-mile missile? Does not that increase the detection and intercept problem?

General BETTS. For us or for them?

Mr. SIKES. Well, it is as long as it is broad. Whoever uses the short range missile gains an advantage insofar as detection is concerned; does it not?

General BETTS. Off the record.

(Discussion off the record.)

DECISION TO PRODUCE

General BETTS. What makes this so tough in this whole area of "shall we produce or shall we not produce" is this 4-year leadtime that you have had explained to you to get from the day you make the production decision to the day you have the first operational capability on site. One cannot build an overall defense complex overnight. This means that the real leadtime to an acceptable capability is some 6 or 7 years, in which case the enemy, once you make this kind of com-

mitment, has some 6 or 7 years to figure ways to defeat this fixed in-place system.

Most of the work we are doing is in exploratory work toward the discriminaton problem. There is some of it directed towards the kill mechanism problem, and a very small part of it toward the development of interceptors. But, our big money is on these radars and atmospheric physics and that kind of thing. Everything we are doing has some effect on the technological problems for NIKE-ZEUS. We might well come up with the discrimination factor.

NIKE-ZEUS

Mr. SIKES. You seem to be reasonably optimistic about the NIKE-ZEUS but I regret to state that I am pessimistic about it. To me the idea of hitting a bullet with a bullet is almost an incomprehensible thing.

General BETTS. If the bullet expands out at the other end to the diameter of an atomic or nuclear kill, I do not think it is hitting a bullet with a bullet. If it were, in fact, then I might share some of your pessimism.

Mr. SIKES. Then you are catching the bullet in a net?

General BETTS. Something like that.

MIDAS PROGRAM

Mr. SIKES. I notice you did not seem to stress MIDAS in your program.

General BETTS. This is not one of ARPA responsibilities, sir.

Mr. SIKES. Do you have any ideas on it? We were concerned about it in the earlier discussion because we were thinking that a big forest fire or a major industrial explosion might trigger the MIDAS the same as a missile launch will do.

General BETTS. I would have to support technically the discussion which Dr. York had with you.

WHAT IS BEST DEFENSE

Mr. SIKES. Let us get into another field:

This is a multibillion program. If you project yourself a few years into the future, any one of the several projects we have been discussing could become a multibillion dollar program. This is a sort of sky-blue thing.

It seems to me, based upon what you have told us, that you can go back to the old, old, old statement that the best defense is still a good offense, and one of the best things we can do in this country is to abandon the declaration that we are always going to await the first blow.

Will you discuss the first part of my statement—is the best defense still a good offense in this field?

General BETTS. In terms of what we know today about defense against the ICBM, it is certainly a tossup at the most optimistic evaluation. It is certainly a tossup as to whether or not one should put his money in more offensive systems than more defensive systems.

This is somewhat out of the ARPA problem.

The thing that impressed me most about this study, and about several other studies in this area, is that if we want to defend people—and, after all, this in the last analysis is what makes a country great—then the first thing we have to do is be serious about civil defense and about the passive defense of people.

LEADTIME FOR NIKE-ZEUS

Mr. SIKES. Even if we can make NIKE-ZEUS work effectively, or whatever follow-on weapon is devised, what is the earliest time that we could anticipate an effective defense against missiles?

General BETTS. I would have to postulate that we do, in fact, conclude that the ZEUS system would be an effective system. The leadtime to a capability is from 6 to 7 years in terms of a complex or a deployed operational capability. For all systems that we are looking at in ARPA, our leadtime is longer than that because we have not even demonstrated the technical feasibility of things which look beyond the ZEUS capability.

PROBLEM OF NUCLEAR FALLOUT

Mr. SIKES. In view of the problem of fallout which certainly will accompany any major missile attack, is this whole thing of defense rather academic? Are you not going to get the people killed by fallout even if you are able to avoid the effects of the missile burst?

General BETTS. No, sir. I do not think that one should give up on fallout, because a relatively few hundred dollars per family would actually save millions of lives, if we are really serious about expecting the Russians to pull the all-out war.

Mr. SIKES. Let us assume we are serious about a massive nuclear attack, and if we are not serious about it, we are wasting a lot of money in many fields.

General BETTS. Then, we should certainly be serious about passive defense.

Mr. SIKES. What, in the main, should passive defense consist of?

General BETTS. Primarily, just a fallout shelter per family. It is the only thing that makes any practical sense in terms of short warning time. In other words, right then and there the ones who are not blasted out of existence get down into fallout shelters. It is the only practical defense I know of.

Mr. SIKES. Do you foresee any substantial progress in eliminating the radar blackout from high nuclear explosions?

General BETTS. Off the record, please.

(Discussion off the record.)

METALS RESEARCH PROGRAM

Mr. SIKES. One of ARPA's newest programs is metals research. Just about everyone we talk to is interested in metals research.

How do you avoid duplication?

General BETTS. This is the materials research program which I mentioned, Mr. Sikes. It is to be an interdisciplinary program at the individual universities which we support. The technical management, while it is centered in ARPA, will be handled by a com-

mittee including the Army, Navy, and Air Force. If it is possible in any way to avoid duplication of this effort, we have set up as good a mechanism as possible.

ANTIJAMMING DETECTION

Mr. SIKES. How can you build antijamming detection into the satellite frequency channels when you cannot build it into present day radio broadcasting activities?

General BETTS. Off the record, please.

(Discussion off the record.)

PROBLEMS OF DETECTION

Mr. SIKES. Why did it take so long to identify the DISCOVERER capsule in the polar orbit?

General BETTS. The only explanation I could give to that is that our system is new and we have a lot of learning to do about how to use it. It is not complete yet.

Frankly, there are dozens and dozens of things which get detected every day. Every time there is a detection, they have to go through and make the computation to find out its course and altitude and either reject it as an airplane or a meteor or otherwise identify it. It is one of those things which we will design out of the system with time and experience.

Mr. SIKES. It could take several days.

General BETTS. It took months before we finally got it. We did not know we had it until——

Mr. SIKES. That is what disturbs me.

General BETTS. We did not know we had it until comparatively recently.

Mr. SIKES. It seems quite slow.

General BETTS. This is a matter of getting experience in the system. I think there are things we can do technologically to improve the ability of the fence to get a stronger signal, but we also have some learning to do about rejecting spurious signals.

Mr. NORRELL. Gentlemen, I have been very much interested in and have enjoyed your remarks today. I am inclined to believe that no one knows too much about this discussion. I would know very little myself.

You have discussed all of the military intelligence and the scientific intelligence so far as I know that we have. Again I say I have enjoyed your statement very much.

EXOTIC FUELS

Mr. FLOOD. General, I have since the early days when we started talking about exotic fuels—and for the purpose of trying to give birth to solid propellants—been thinking ahead of MINUTEMAN and POLARIS, but going back several years, we were talking about beryllium.

In your metals research I know how expensive it is and I know of their expensive properties.

BERYLLIUM

Are you developing any horizon for the practical application of beryllium? I know of your difficulty with its low fracture, but what is its potential for structural work other than this small use now within missile casings and so on?

General BETTS. When you get to the point of worrying about the use of metals for actual structural application, it is beyond the basic research nature of what ARPA is supporting. But, I can say that generally we are beginning to make progress.

Mr. FLOOD. That is true, but broadly speaking there is no immediate horizon for widespread structural use for beryllium because they, or you, have not yet licked that low fracture point.

General BETTS. I think there are several things which we have not licked. One is the job of fabrication which you mentioned. It is a difficult material to work with and it is expensive, and one has to have a very important application of it before one is willing to put up with these shortcomings.

In our interdisciplinary laboratory program we will ultimately learn new things about beryllium as well as other materials, but I cannot predict when you would see results. I would expect 5 years.

NEW PROPELLANTS

Mr. FLOOD. Let us talk about the use or uses in your solid fuels for the purpose of propulsion. You spent a chapter in your presentation in your groping into the area of propulsion to extend by 5 percent, 10 percent, 15 percent, or 17 percent the thrust potential. While solid fuels have many desirable properties for transporation and other things, yet they lack what the liquids so far have produced in thrust. We have to sacrifice for some advantages the disadvantages of power and thrust.

I believe you indicated that to produce your goals, you are certainly not short of 5 years?

General BETTS. No, sir. I think that some of the new propellants we are talking about in the ARPA program have little likelihood of getting into actual usage in something short of about 5 years, but I am not sure that there are not intermediate steps in terms of application of things already being done in solid propellants that may succeed in getting a propellant to the point where it would upgrade the POLARIS in 3, 4, or 5 years. But, it is not a tomorrow proposition.

EXOTIC METALS

Mr. FLOOD. When we talk about ion motors for space travel—interplanetary space travel—I am curious about this metal which my German friend calls "cesium" but which you call "casium."

With reference to these new exotic metals, I first ran into this cesium business when we were talking about the sniperscope when General Gavin discussed the value of the cesium metal in the photoelectric cells—first, in our shop in the sniperscope and then the snooperscope. What are you people doing, are you ARPA people, in your materials research to develop this cesium for the purpose of developing this thrust in the ion motor?

Is there any application of that other than in the interplanetary realm?

General BETTS. When we had responsibility for the military aspects of the space program, ARPA was then supporting several of these ion propulsion ideas. Things of that sort in the ARPA effort were before my time.

I would like to ask if Colonel Lay could respond to that?

Mr. FLOOD. I am reaching for a 3,000-mile POLARIS.

General BETTS. I do not think that cesium as such feeds back into this.

Mr. FLOOD. Apparently these new exotics, as part of the thrust for an ion motor, then their value is in interplanetary movement and not in the ICBM range at all.

General BETTS. That is right. It is a very different proposition. Those are very low levels of thrust, and the mechanism that is of interest in those cases for ion propulsion is a completely different mechanism from that in which we are interested for solid propellants.

Mr. FLOOD. Then, I have to abandon my hope of bringing you down to that POLARIS from 1,500 to 3,000 miles.

Well, I had a good idea at 2 o'clock this afternoon.

General BETTS. I think you have to abandon it for POLARIS.

PROTECTION OF POLARIS SUBMARINE

Mr. FLOOD. All right.

I tried to get some of your predecessors to discuss with me what then grew out of a Navy argument with reference to the Navy's development of a defensive impulse for mine protection around certain of its surface craft. Since the POLARIS submarine is not a killer sub, we were wondering how we could protect it and we were talking about putting a screen of impulses around the ship and then into other ships to protect her from mines and torpedoes and from attack.

How far into the realm of protecting the continental United States can you project that? How far out can you go or should you go or would you go or would you want to go to put around the continental United States some place something like the Navy wants to put around the POLARIS or around a destroyer in order to protect it from submarine attack or to protect it from torpedoes or from any attack? What kind of impulse could you perfect and what kind of a fence radar could you establish? To this end have you examined the Van Allen radiation belt?

General BETTS. I do not know of anything technologically speaking that fits this kind of a mission. It is a sort of a dream thing which the military has always hoped to come to, but there is no fence and nothing that can be set up of that nature that we think is practical.

Mr. FLOOD. That, of course, would be the ultimate in this kind of screening—some kind of fence defense. You could go to bed and know some place up there there is a fence of radars or a screen or something else through which it would be impossible for any foreign object to penetrate, either beam or rocket or missile or aircraft or anything else.

General BETTS. Ever since the phalanx men have thought of the impenetrable defense, but it just does not exist.

Mr. FLOOD. I come back again to my metals such as beryllium and cesium and these other exotics for propulsion.

INTERPLANETARY IONIC MOTOR

Are you in this interplanetary ionic motor business?

General BETTS. No. We were when we were responsible for the space program, but that has since been turned over to the Air Force.

Mr. FLOOD. Then, there is no sense in talking about that to you.

NUCLEAR ROCKET PROPULSION

Are you engaged in research of any kind in any part of your shop in nuclear rocket propulsion?

General BETTS. No, sir, this is not now one of our responsibilities.

Mr. FLOOD. Is that the responsibility of AEC?

General BETTS. That is the responsibility of the AEC and the Air Force. The Air Force has the military interest and NASA is also in that area.

Mr. FLOOD. The other day I brought to the committee and to Dr. York the day before yesterday some more detailed information which I obtained from some of my strange sources of information on the Swedish double or triple agent who was talking to a German in Hamburg last week on the Russian nuclear rocket and the use of hydrogen ignited by oxygen.

Do you know any more about that than I do, or have you heard?

General BETTS. I do not know anything about it—I will put it this way: I do not have any knowledge of what the Russians are doing in this area. I read the newspaper account of that thing but, frankly, at the moment take a rather detached view of it, to say the least.

Mr. FLOOD. It is not in your shop?

General BETTS. No, sir, it is not one of our responsibilities.

SPACE VEHICLE CONTROL

Mr. FLOOD. In your affirmative statement you were discussing the realm of communications. It looks as though we are going to need some kind of traffic cop up there sooner or later, both friendly and otherwise. What do you have in mind with all this garbage flying around up there? You listed 40 or 50 different types and kinds of satellites here in one hour in your shop. There are a half dozen people like you in the Pentagon and heaven knows how many in other capitals all over the world. Now the French are in the act and I understand the Chinese are breathing down our neck. All this garbage will be flying around there. How do you propose to put a traffic cop up there beginning with your own?

General BETTS. The point of control has to be on the ground, no question about that. I would certainly say that one has to agree with the U.S. position, as expressed to the U.N., that we ought to have an international mechanism for the control of what goes up into space.

COMMUNICATIONS SATELLITES

Mr. FLOOD. That was my next question. What do you people in your areas talk about? You were saying we will send up a satellite with nine channels, another with 24 channels. How many channels are there? How many are you going to have? I know the radio world and television world, even now we sit at Geneva and discuss channels. Upstairs are you not magnifying the problem?

General BETTS. No, sir. This is why we do not propose today to put up what we call a 24-hour communication satellite. That means one at about 19,000 miles that would, therefore, seem to stay fixed in space. We feel that it would have broad coverage of the earth. The frequencies on which it operates must be very high indeed, must be outside of any of the communication channels we are using today for things like communications to ships at sea, for our present military worldwide communications which are in the high frequency band.

We are talking about frequencies as high as 8,000 megacycles, which is very much higher than anything we have now. The reason we are talking about that kind of frequency is we want to get out into new bands that are not cluttered up with other things. It looks as though it is the only way we can get allocation of the numbers of channels we are talking about.

Mr. FLOOD. Your opposite number is doing pretty much the same thing, you are sure, you must take for granted he is, no matter what you know he is doing.

General BETTS. He has a different problem; he has interior lines. He does not have major bases scattered all over the world that have to communicate back and forth and intercommunicate. He has a very different problem from ours.

Mr. FLOOD. That is the situation as of this afternoon. That Maginot line concept will not help us.

General BETTS. It might change.

Mr. FLOOD. You project your thinking into the time period you use for the rest of your paper and you cannot be quite so firm on that.

General BETTS. Your position is well taken.

Mr. FLOOD. This fellow is getting around. My bewildered and bewhiskered friend in Cuba is playing footsie with him.

General BETTS. He might very well want to communicate with Cuba by satellite.

NIKE ZEUS

Mr. FLOOD. As far as ZEUS is concerned, we come back basically to the Achilles heel—this is mixing up the Greeks, they do have words for things. The Achilles heel, for want of a better name, of the ZEUS system to us laymen is this business of discrimination of picking out that warhead.

General BETTS. It is the most difficult problem in ballistic missiles because of this 6 years' time that is involved between now and the time when one could get numbers of these defensive systems deployed and in the field.

OPERATION ARGUS

Mr. FLOOD. Your people came in a couple years ago and you were all excited, took up a whole hour or so telling us about Operation

Argus. They were all upset about this Argus. Now it suddenly poohed out. What happened to Argus?

General BETTS. We got a great deal of information from Argus.

Mr. FLOOD. Nobody has said anything to us about Argus in 2 years. Why?

General BETTS. We conducted the experiment, we analyzed the data.

Off the record, please?

(Discussion off the record.)

Mr. FLOOD. Another problem you have with your question of ZEUS is your lack of knowledge of the atmosphere beyond one earth radius. Is there anything, do you have any hope, do you have any reasonable cause to believe that insofar as that one element of this complicated ZEUS success deals with the ionosphere, is there anything around the corner Sunday afternoon which will give you a breakthrough in the ionosphere or that atmospheric search which will simplify this discrimination on that warhead?

(Discussion off the record.)

Mr. FLOOD. Then the answer to my question is "No"?

General BETTS. The answer to any good solid promise is "No."

ORDIR

Mr. FLOOD. I am interested in a word or two more about this Ordir concept of triangulating a hatful of these radars. I understand the triangulation process as we used to triangulate 15 years ago ground radio. The principle is the same?

General BETTS. Exactly the same.

Mr. FLOOD. What do you do with Ordir which would permit you to triangulate? Over how much geography do you triangulate? Are these baseball field radars like the BMEWS? What do you mean?

General BETTS. These would be radar dishes pretty much as we know them today, but the baseline between radars is the point that gets really interesting. In other words, if we establish a baseline of from tens of miles to 200 miles——

Mr. FLOOD. Do you mean a line?

General BETTS. That much distance between the two radars of interest. Then the question of precision with which we can locate individual objects in a cloud gets to be much higher than we can do with a conventional single radar technique.

Mr. FLOOD. When you talk about debris and garbage and decoys and multiple warheads, it looks to me as though this Ordir business of triangulating a cluster of radars is the most sensible procedure of the whole lot.

General BETTS. It may be, but there are problems.

Mr. FLOOD. Is it two radars? Why not a family?

General BETTS. Two or three or four, however many are introduced.

Mr. FLOOD. After that you have this speed of communication to the fighting area.

General BETTS. This will require data links of very high quality.

Mr. FLOOD. That would be true no matter what system or combination of systems you use.

General BETTS. That is right.

Mr. FLOOD. You have nothing to do with that?

General BETTS. We do not have to do with the communications problem as such. It is something we would use in the process of putting together material.

ESAR

Mr. FLOOD. I only have time for one more. I do not understand on this ESAR, the electronic aiming of radar at an object as against a process of mechanically aiming a radar. Is that automatic? What do you mean by electronic aiming of a radar? What difference would it make?

General BETTS. To get a radar signal you have to have emitters. The emitter is related to the power, the pulse you can put into a given emitter. All of our radars are in some measure limited by the size of the components and how much power we can get into a single emitter.

Mr. FLOOD. What is the aiming?

General BETTS. If we can work out a radar where there were several emitters all putting out pulses over a large area, let us say, by electronic and computer techniques we can program the emissions so that they reinforce one another and focus on a single point. By shifting the phase of the emissions, we can move the point electronically. Then we can, in effect, multiply the power of all of these emitters.

Mr. FLOOD. That would help you on the Ordir?

General BETTS. That gives you a very high-powered radar. It is different thing from Ordir where you have dishes. This is a matter of individual emitters.

Mr. FLOOD. Actually move your impulse electronically?

General BETTS. That is right.

Mr. FLOOD. Thank you; that is all.

Mr. MAHON Mr. Ford.

NIKE-ZEUS

Mr. FORD. General Betts, we have heard from a number of people their observations and comments concerning NIKE-ZEUS. I have the impression that this program has been studied about as extensively by the Army, Defense Department, ARPA, and others as anything could be to determine what is the right course to pursue. Would that be your general observation, too?

General BETTS. Not exactly, Mr. Ford.

Mr. FORD. I gather that is the reason why you and others subscribe to this continuation of an active research, development, and testing program as contrasted to a production program.

General BETTS. To move the R. & D. program as fast as it is technologically feasible to do so; yes, sir.

Mr. FORD. As I intimated before, it seems to me there have been panels set up by the Secretary of Defense and others that have studied and restudied this, and it is my impression that the nearly unanimous conclusion is that this program that has been recommended to us is the right course for the next fiscal year. Is that a fair summary of the information you have on what has transpired?

General BETTS. From my information, this is a fair summary.

CHANGES OF MISSILE COURSES

Mr. FORD. On page 5 of your prepared text—and this is the first time I have read it—you say that missiles can have their own courses altered. I have never heard that said before.

General BETTS. This costs money and it costs complication, but it can be done.

Mr. FORD. Ballistic missiles can have their course altered?

General BETTS. Certainly.

Mr. FORD. It prevents him from hitting a predetermined target with the accuracy we expect to have and that we assume they have?

General BETTS. It makes it more difficult.

Mr. MAHON. It would get his fallout on you without your shooting him down with a NIKE–ZEUS, probably.

General BETTS. If we make it so difficult for him to penetrate that he looks for every possible means of defeating a defensive system, and if we look at the situation as things may be 6 years from now and what he can do, this is not impossible.

Mr. FORD. You are not saying he can alter his course for another target in flight with the same degree of accuracy he would have had with his initial launch?

General BETTS. We are saying that he can take evasive maneuvers to change its course upon reentry. This costs him something. It costs him complexity and, therefore, reliability and it will probably cost him in accuracy.

Mr. FORD. That is all, Mr. Chairman.

Mr. MAHON. General, we appreciate your appearance and your helpful testimony. Thank you and your assistants for being with us.

MONDAY, MARCH 14, 1960.

RESEARCH, DEVELOPMENT, TEST, AND EVALUATION, ARMY

WITNESSES

LT. GEN. ARTHUR G. TRUDEAU, CHIEF OF RESEARCH AND DEVELOPMENT
MAJ. GEN. ROBERT J. WOOD, DEPUTY CHIEF OF RESEARCH AND DEVELOPMENT
MAJ. GEN. W. W. DICK, JR., DIRECTOR OF SPECIAL WEAPONS, OFFICE OF THE CHIEF OF RESEARCH AND DEVELOPMENT
MAJ. GEN. DAVID W. TRAUB, DIRECTOR OF ARMY BUDGET, OFFICE, COMPTROLLER OF THE ARMY
MAJ. GEN. E. F. COOK, DEPUTY CHIEF SIGNAL OFFICER
BRIG. GEN. WILLIAM J. ELY, DIRECTOR OF ARMY RESEARCH, OFFICE OF THE CHIEF OF RESEARCH AND DEVELOPMENT
BRIG. GEN. FRANK H. BRITTON, DIRECTOR OF DEVELOPMENTS, OFFICE OF THE CHIEF OF RESEARCH AND DEVELOPMENT
BRIG. GEN. L. J. LINCOLN, DIRECTOR OF PLANS AND MATERIEL, OFFICE OF THE DEPUTY CHIEF OF STAFF FOR LOGISTICS
BRIG. GEN. J. T. SNODGRASS, DIRECTOR OF AIR DEFENSE AND SPECIAL WEAPONS, OFFICE OF THE DEPUTY CHIEF OF STAFF FOR MILITARY OPERATIONS
C. R. WOODSIDE, OFFICE OF THE CHIEF OF RESEARCH AND DEVELOPMENT

Program and financing

	1959 actual	1960 estimate	1961 estimate
Program by activities:			
Direct obligations:			
1. Military sciences	$123,320,342	$159,107,000	$150,993,000
2. Aircraft and related equipment	54,484,996	36,274,000	36,618,000
3. Missiles and related equipment	423,184,926	495,507,000	493,808,000
5. Ships and small craft and related equipment	2,355,101	916,000	150,000
6. Ordnance, combat vehicles, and related equipment	118,907,302	108,711,000	88,589,000
7. Other equipment	212,244,775	204,703,000	185,978,000
8. Programwide management and support	87,026,790	96,157,000	187,215,000
Total, direct obligations	1,021,524,232	1,101,375,000	1,143,351,000
Reimbursable obligations:			
1. Military sciences	496,000	3,326,000	3,553,000
2. Aircraft and related equipment	2,000	2,000	2,000
3. Missiles and related equipment	67,258,446	5,415,000	2,149,000
6. Ordnance, combat vehicles, and related equipment	247,000	208,000	208,000
7. Other equipment	1,019,000	1,221,000	1,191,000
8. Programwide management and support	232,000	250,000	315,000
Total, reimbursable obligations	69,254,446	10,422,000	7,418,000
Total, obligations	1,090,778,678	1,111,797,000	1,048,918,000

Program and financing—Continued

	1959 actual	1960 estimate	1961 estimate
Financing:			
Comparative transfers from (−) other accounts	−$469,834,947	−$27,490,000	
Unobligated balance brought forward	−55,180,525	−57,441,990	−$29,921,990
Unobligated balance transferred from "Procurement of equipment and missiles, Army" (73 Stat. 376)		−10,000,000	
Advances and reimbursements from—			
Other accounts	−61,349,432	−10,366,000	−7,360,000
Non-Federal sources (5 U.S.C. 172d)	−85,014	−56,000	−58,000
Unobligated balance carried forward	57,441,990	29,921,990	30,121,990
New obligational authority	561,770,750	1,036,365,000	1,041,700,000
New obligational authority:			
Appropriation	507,345,000	1,035,715,000	1,041,700,000
Transferred from—			
"Emergency fund, Department of Defense" (72 Stat. 713; 73 Stat. 377)	43,004,000	650,000	
"Salaries and expenses, Advanced Research Projects Agency, Department of Defense" (72 Stat. 712)	15,500,000		
Transferred to "Research and development, National Aeronautics and Space Administration" (72 Stat. 433)	−4,078,250		
Appropriation (adjusted)	561,770,750	1,036,365,000	1,041,700,000

Object classification

	1959 actual	1960 estimate	1961 estimate
ARMY			
Total number of permanent positions	17,107	13,989	13,994
Full-time equivalent of all other positions	32	31	31
Average number of all employees	15,914	13,183	13,196
Number of employees at end of year	17,747	13,983	14,013
Average GS grade and salary	9.0 $7,127	8.8 $7,080	8.8 $7,089
Average salary of ungraded positions	$5,409	$5,415	$5,415
Personal service obligations:			
Permanent positions	$104,900,881	$84,520,092	$85,181,952
Positions other than permanent	154,480	155,877	159,311
Other personal services	6,104,052	4,613,031	4,031,737
Total personal service obligations	111,159,413	89,289,000	89,373,000
Direct obligations:			
01 Personal services	99,020,283	88,473,000	88,557,000
02 Travel	6,456,133	5,032,000	5,100,000
03 Transportation of things	13,193,466	14,726,000	13,848,000
04 Communication services	440,176	491,000	462,000
05 Rents and utility services	3,485,636	3,890,000	3,658,000
06 Printing and reproduction	142,704	159,000	150,000
07 Other contractual services	499,305,329	546,576,200	515,157,300
Services performed by other agencies	46,772,000	52,206,236	49,093,400
08 Supplies and materials	163,845,564	182,884,200	171,975,300
09 Equipment	161,151,727	179,878,000	169,148,000
10 Lands and structures	18,264,345	20,387,000	19,170,000
11 Grants, subsidies, and contributions	4,553,565	5,083,000	4,780,000
13 Refunds, awards, and indemnities	192,979	215,000	203,000
15 Taxes and assessments	164,970	184,000	173,000
Total direct obligations	1,016,988,877	1,100,184,636	1,041,475,000
Reimbursable obligations:			
01 Personal services	12,139,130	816,000	816,000
02 Travel	415,527	28,000	28,000
03 Transportation of things	1,815	200	200
04 Communication services	13,851	1,600	1,600
05 Rents and utility services	62,329	7,000	7,000
07 Other contractual services	52,819,725	9,162,000	6,158,000
08 Supplies and materials	3,739,740	400,000	400,000
09 Equipment	48,478	5,600	5,600
11 Grants, subsidies, and contributions	13,851	1,600	1,600
Total, reimbursable obligations	69,254,446	10,422,000	7,418,000
Total, Army	1,086,243,323	1,110,606,636	1,048,893,000

Object classification—Continued

	1959 actual	1960 estimate	1961 estimate
ALLOCATION ACCOUNTS			
Full-time equivalent of all other positions	1		
Average number of all employees	13		
Number of employees at end of year	2		
Average GS grade and salary	7.1 $5,390		
01 Personal services:			
Permanent positions	$70,116	$285	
Positions other than permanent	6,009		
Other personal services	889		
Total personal services	77,014	285	
02 Travel	1,351		
03 Transportation of things	7		
04 Communication services	36		
07 Other contractual services	3,633,584	1,126,417	$25,000
08 Supplies and materials	4,026		
09 Equipment	1,300		
10 Lands and structures	813,741	63,662	
11 Grants, subsidies, and contributions	4,188		
13 Refunds, awards, and indemnities	10		
15 Taxes and assessments	98		
Total, allocation accounts	4,535,355	1,190,364	25,000
Total obligations	1,090,778,678	1,111,797,000	1,048,918,000
Obligations are distributed as follows:			
Army	1,086,243,323	1,110,606,636	1,048,893,000
Navy	961	5,000	
Atomic Energy Commission	4,444,554	1,185,079	25,000
Federal Aviation Agency	80,438		
Veterans' Administration	9,402	285	

Mr. MAHON. The committee will come to order. Our subject this morning for consideration is "Research, development, test, and evaluation," on which we will hear all the services. We will take the Army first on this subject.

I heard someone say a very short while ago that it may be true that war is entirely too serious a business to be left to the generals. It was also indicated that probably war is entirely too serious a business to be left to the scientists. No doubt, there is room for all segments of our resources in preparation for modern war, cold and hot, big and little.

Once I said that many crimes had been committed in the name of liberty and research and development. It is true that the idea of research and development is very popular in our country. We are all in favor of progress. Congress has always been liberal in appropriating research and development funds. Since research and development funds have been easy to come by, this vehicle has been used as a cover to secure funds for purposes which offered little promise of benefit. I do not mean that adequate funds for research and development in appropriate fields should not be provided. The sky should be the limit in certain high priority areas.

I think we have cleaned up our houses somewhat in this area of research and development. We certainly should not use research and development as a cloak to do things that otherwise have no basis in the military program. On the other hand, we should not underfinance this highly important field.

We will be interested in knowing, General Trudeau and others, what your thoughts are in regard to the validity of these programs. At times it seems to me we have put stress on research and development of a very questionable type and have neglected the more important job. I hope that is no longer the case.

I think we can best proceed by listening to your statement, General. We are pleased to have you before us and we shall listen with interest to your evaluation of research and development requirements of the Army. You may proceed.

General Statement of the Army Chief of Research and Development

General Trudeau. Mr. Chairman and members of the committee, I am Lt. Gen. Arthur G. Trudeau, Chief of Army Research and Development. I would like to outline for you this morning the Army's research and development program and to place it in proper perspective with respect to the missions currently assigned to the U.S. Army.

I cannot help injecting at this point, in view of the chairman's remarks, that while research and development may be made to appear somewhat iniquitous, that in this respect and considered with all other agencies, I do not know that that would be unique.

THE COMMUNIST THREAT

Today, to peace-hungry multitudes throughout the world family of nations, the siren song of Soviet coexistence rings sweet with promise. Fortunately, it has yet to drown out the doctrine; "deeds, not words." Recent Soviet announcements of reductions in Armed Forces cannot today be rationalized as representing reduced capabilities, in fact. Even if such reductions in their military forces actually are accomplished in the future, there is little question that numerically the Sino-Soviet bloc forces will continue to overbalance those of the United States and its allies. You can be assured that their motives in this matter are to add to our complacency at the same time they reduce pressures on their agriculture and their industry. As a long time student of communism, I am convinced that the Communist intention to gain world domination remains unchanged. They have clearly stated many times that their objective is to destroy us. This cold hard fact can still be seen through the thin veneer of shifting tactics from the Kremlin.

Since World War II, each Communist thrust at vital economic areas and underdeveloped countries throughout the world has reemphasized the need of this Nation for a modern Army as part of our ready forces to implement our national policy objectives. And whether the future brings general war, limited war, or only continuing international tension, our Army will continue to be a vital factor in maintaining the security of the United States and the free world.

A key part of the Army's program to accomplish this mission is our research and development program which leads to the production of new and improved weapons systems and materiel necessary

for immediate, vigorous, and successful reaction to aggression in any form, anywhere. The Army, more than any other service, in both general or limited types of war, faces the preponderance of enemy manpower and equipment. It must be superior to that force—progress in science and technology is the key to attaining that superiority.

Today, Russia and the West are racing to advance military technology with a concentration of resources approached in the past only in wartime. We dare not lag behind in this contest. For this reason, it is mandatory that we increase our efforts and our expenditures on military research and development as well as in procurement.

THE LEADTIME PROBLEM

We are very much concerned with the dimension of time in research and development. In some respects, it is more critical than funds. We know that we must meet the continuing and changing Communist threat with the broadest possible research and development program leading to the earliest possible availability of new equipment.

As I mentioned last year, the early availability of new weapons and equipment is not only dependent upon availability of funds, it is also influenced by leadtime. Money can buy many things, but it can't buy time—time lost through lengthy administrative procedures, deferred decisions, lack of vision, timidity, complacency, misdirected or fruitless effort, or through inadequate funding.

We can define leadtime as the period from wanting to getting. More specifically it is the time from the concept or initiation of a project until the finished hardware is delivered to the using troops. At the present time, it takes some 7 to 8 years to complete this cycle in the United States. This time covers research, development, testing, and production. When compared with the Soviet leadtime of about 5 years, we can see we have a serious problem at the national level.

We must shorten our leadtime and field new weapons systems more rapidly if we are to retain a military advantage over the Soviets and with it the military strength and flexibility required to support a viable and effective foreign policy or to win any type of conflict which might be forced upon us. We must reduce leadtime to an irreducible minimum. As an example, if a technological breakthrough is achieved today, it may not be until 1968 that we can have a new family of developments operational. In contrast, with their average current 5-year leadtime for major items, the U.S.S.R. could acquire new information 2 years later than we—by subversive means perhaps—and still beat us to the punch with a new weapon or counterweapon. This is the real meaning of leadtime to us. We are extremely conscious of the need for a drastic improvement of our funding and management techniques. We know we must achieve a cycle of 4 years. This is a positive step required to keep obsolescence from undermining our new developments.

As you know, administrative and funding procedures can hamstring know-how. We are convinced that these procedures must be made less complicated to permit exploitation of the advantages we

enjoy in scientific and technological knowledge. We are striving to reduce leadtime through intensified Army-industry teamwork and through new procedures for expedited development.

Expedited development permits overlapping and telescoping of some phases of the R. & D. cycle. Some of this is done by conducting user and engineer testing concurrently or on a combined basis. Production engineering and tooling must be started as early in the development cycle as possible. By these steps, we expect to reduce significantly the leadtime on our missile projects. Our best record to date on leadtime has been with the JUPITER missile program. The time for that development was 3 years, and it indicates what can be done with simplified procedures and concerted effort by all agencies concerned. We expect the time of development for DAVY CROCKETT to be equally as good.

We are also trying to reduce leadtime by freezing a good design earlier without spending time and money in developing something better—the optimum design. Enthusiasts and perfectionists often want unnecessary refinements in our equipment, but I can assure you that the Soviets are not so naive. There is a Soviet saying worth repeating here: "the better is ever the enemy of the good." We are trying hard to reduce costs in time and money by seeking reliability with simplicity and by adhering to commercial practice and components to the maximum extent feasible.

Recent Soviet missile tests in the Pacific have offered dramatic testimony to the increasing Soviet ICBM capability, and our critical need for an adequate defense against these weapons.

NIKE-ZEUS

To provide such defense against both ICBM's and sub-launched IRBM's at the earliest possible date, the Army is pressing development of the antimissile NIKE-ZEUS system on an urgent basis.

NIKE-ZEUS is the only antimissile defense system under hardware development in this Nation today, and to our knowledge it is the only such system underway in any nation of the free world.

I submit as reassuring the fact that ZEUS development is in the hands of the same experienced Army-industry team which successfully developed the currently operational Army air defense weapons systems—the NIKE-AJAX and NIKE-HERCULES—now girding America's great centers of population and industry—Los Angeles, Boston, Chicago, New York, this National Capital, and others.

Our development program for NIKE-ZEUS is proceeding in accord with the time schedule we established some 2 years ago. Important milestones in this program have been met on schedule. Major elements of the system have been successfully tested. Initial flight tests at White Sands Missile Range have advanced the program. Several flights of test vehicles have been conducted so far. NIKE-ZEUS now is scheduled for an advanced system test at White Sands, and later our plans are to test it in the Pacific at Kwajalein Island. At present, construction at the Kwajalein test site is underway. We are on the threshold of the next step.

I am pleased to report to the committee that since my last appearance before this committee there have been continuing demonstrations of the growth potential of the NIKE-ZEUS system. Design changes,

resulting in significant improvements in system performance, have already included increases in power and in sensitivity of radars, and improvements in the design and effectiveness of the missile itself.

On the basis of progress to date, I am confident that the ZEUS system will achieve its design objective, that its growth potential is dynamic, and that it can and will be sucessfully developed to meet and master the ballistic missile threat of the Soviet Union and extend our knowledge toward meeting the satellite threat in the offing.

RESEARCH

Now I would like to mention briefly the scope of our Army research and development program. It is divided into two general effort areas; first, basic research; second, applied research and development. Both lead to the production of hardware.

The extent of our research effort is measured in terms of some 2,600 research projects spread across 16 major scientific disciplines and 74 subfields, ranging from mathematics, human factors, and medical projects to investigations in tropic and arctic regions. This research is monitored by my office and the Army's 7 technical services at 52 U.S. Army locations, 21 other Government agencies and over 550 U.S. colleges, universities, research institutions and other contract organizations.

Basic research is crucial. It is the chief determinant of progress in the weapon art of this decade, and beyond. The Army clearly comprehends the need constantly to expand the horizons of basic research, to outmaneuver and to outdistance the Communists in this critical area.

It is a truism that, in every age, great advances always have reflected the genius, talent, and leadership of a few particular individuals. Therefore, great value is placed by the Army on the service of the lone, creative men of science both in and out of uniform, and of the small research teams engaged in these projects. From their dedicated and industrious labors inevitably come the basic breakthroughs so vital to defense readiness in troubled times.

It gives me satisfaction to report to you gentlemen that, since last appearing before this committee, there has been a substantial increase in the number of non-Government agencies participating in our research program. Also, we are utilizing contributions from leading scientists in 14 countries of Europe and Japan. Insofar as funding permits, we are leaving no stone unturned to insure that the Army's research program moves at a high level of endeavor.

We have an aggressive research and development program that is backed by an enthusiastic Army which is fully aware of its responsibilities in national defense. In Army research and development, we are intensely interested in prosecuting an adequate and dynamic program so vital for our national posture and future.

AIR MOBILITY

I now invite your attention to a specific concept of mobility which is receiving increased emphasis in the Army. I am speaking of air mobility—that form of mobility which frees military movement from the age-old shackles of terrain. Today, working with weapons and

vehicles of a revolutionary nature, our forces must have the ability to maneuver rapidly under all conditions. We must be able to disperse or concentrate quickly, according to the demands of either conventional or nuclear combat situations, whatever the problems posed by geography, climate, and the active opposition.

In the circumstances of present and future combat, we cannot depend alone on wheel and track. We cannot be groundbound. We must be able to utilize and control the air envelope over our zone of action in order to defend and to attack effectively. To do this the modern Army must develop and utilize air vehicles combining the peculiar takeoff, hover, and landing characteristics of the helicopter with the advantages of the fixed-wing, forward-flight aircraft. Thus the Army expects to avoid the limitations of long, improved airstrips, heavy engineering support, cumbersome organizations, and the like.

Creation of such specialized Army air vehicles present real challenges to developing agencies. These vehicles must be designed to satisfy conditions peculiar to Army combat in terms of maintenance and performance. They must be able to live with the Army in the field, be constantly available, and immediately responsive.

The aircraft we presently have under development generally meet this requirement of being able to live with the Army. And we are moving ahead. Currently our research and development effort in this field is focusing on three areas: Light observation, manned surveillance, and tactical transport vehicles.

We have initiated a new Army aircraft development plan. Briefly, this plan consists of defining the Army's needs for aircraft development in the three areas, thorough study of the state of the art as applied to these needs, establishing priorities and, finally, initiation of prototype development. To reduce leadtime, the entire program is being accelerated through enlisting maximum aid from other Government agencies and from our industrial partners.

The program is well underway. We prepared three Army study requirements broadly defining our problems. These study requirements were presented to industry at a meeting on December 1, with the understanding that this was not a design competition but rather a request for their best solutions to the problems. Industry was clearly informed that at this stage the program was not funded and that any work they performed must be voluntary. They were told that the Army would use their solutions to determine significant characteristics and priorities for aircraft to be developed during the next few years against the 1965–70 time frame. They were invited to present their concepts to the Army this month.

Industry response has been overwhelming. Almost 50 separate firms have submitted nearly 120 concepts which now have been evaluated by Army technicians, assisted by the other services and the National Aeronautics and Space Administration. The result of this technical analysis has been presented to a senior board of officers, and they, in turn, have made recommendations to the Army Chief of Staff. This week we will present to the Office of the Secretary of Defense our plans for utilizing programed fiscal year 1961 money for aircraft development.

This is a far-reaching program, gentlemen. It will chart the broad course for U.S. Army aircraft development for the next 10 years and point the way to new tactical concepts. The problem of strategic airlift is quite another question now being brought into focus before the Congress.

SURFACE MOBILITY

We also have under development new vehicles designed to give us the improved ground mobility required on future battlefields. This type of equipment, characterized by king-size wheel and tire combinations, has been derived from that used today in commercial earth-moving and heavy construction work. We call this Goer equipment, and its military adaptation gives the first true, off-road mobility required by modern war. These Goer vehicles also have a potential carrier and launching capability for many of the missiles now coming into our arsenal. More conventional trucks will still be required in large numbers.

In the track vehicle field, new tanks and armored personnel carriers soon will be operational to improve our striking power. These track vehicles represent significant improvements over today's tanks and armored personnel carriers in size, weight, reliability, firepower, engine performance, and fuel consumption. Wherever possible, we are distinguishing these with both swim and air-transportable capabilities.

The M–60 tank, designated as the Army's new main battle tank, will replace the present M–48 Patton. It mounts a new 105 mm. gun, which gives more hitting power than the 90 mm. gun of the M–48. The tank is lighter and incorporates a 750 horsepower diesel engine which provides increased operating range and efficiency and reduced fire hazard.

FIREPOWER

Firepower is always a critical part of our program. The Army has improved rifles and other small arms soon to be operational that outperform our present weapons, but we are striving for still better ones tomorrow. Several types of guided missiles and rockets are under development to supplement or replace those now in the hands of troops.

Among these are SERGEANT and PERSHING, both long-range, surface-to-surface guided missiles being developed to fire at ground targets. In the shorter ranges, we have improved our reliability and accuracy of delivery by developing LACROSSE. This is a highly accurate guided missile which will provide all-weather, close tactical support for the frontline soldier. Of course, we still have HONEST JOHN including an improved version and are developing LITTLE JOHN, two very versatile free rockets.

An interesting demonstration of the speed and versatility of the LITTLE JOHN rocket system took place in December at Fort Sill. The rocket and its crew were flown in a helicopter to a launching area. In less than 7 minutes from time of landing, the LITTLE JOHN rocket was launched at a selected target. This feat is convincing proof that the helicopter is another natural carrier for a series of missiles in the Army's arsenal.

The Army has an important mission in air defense not only for the continental United States but for troops in the field. We have under development both a shoulder-fired missile, called REDEYE, for the combat soldier to use at close range against attacking aircraft and

the HAWK missile system to be employed against low flying aerial targets at greater ranges. Its successful destruction of an incoming HONEST JOHN indicates a significant potential.

CHEMICAL-BIOLOGICAL WARFARE

Other additions to our arsenal of future weapons occur in the field of chemical weapons systems. Here we know that the Soviets are putting a high priority on development of lethal and nonlethal weapons, and that their weapon stockpile consists of about one-sixth chemical munitions. Russian leaders have boasted that they are fully prepared to use new chemical weapons of great significance and we know that Soviet forces are trained in their use. If the Communists ever use chemicals, with which they are well equipped, we must be prepared to meet such an attack—both offensively and defensively.

Let me tell you briefly about the interest now being shown in certain chemicals that temporarily are incapacitating—agents that allow personnel complete recovery.

These chemicals are basically of two types. One type is psychochemical which disturbs the normal behavior pattern of the individual, causing either apathy, fear, or disorientation of the mind. The other type is incapacitating physically, causing, for example, temporary blindness or paralysis. These two chemical agents could be used against an enemy without causing fatalities or large-scale destruction of buildings, bridges, and other manmade structures.

COMMUNICATIONS AND ELECTRONICS

In communications and electronics, we are striving to match the requirements of the dispersed battlefield as well as our intelligence requirements to locate targets rapidly for our new missile weapons and the others that are to follow. Electronics in general has seen a tenfold increase since World War II and another tenfold increase can be expected by 1970. This is the fantastic area of development where the old vacuum tube circuits are now being microminiaturized to one-tenth, one-hundredth, and even one-thousandth of their original size and volume. This means a tremendous savings in bulk, weight, and power requirements for an across-the-board application to all types of Army equipment.

For combat surveillance we now have better photographic, radar, infrared, and television means under development to survey the battlefield and assist in location of enemy targets. Our surveillance drone program will give the field Army commander a capability of surveillance for hundreds of miles forward of his most advanced combat units.

In this same area we are working on automatic data processing systems to sort and evaluate enemy information so that the commander will have the intelligence he needs for a rapid decision—important in timely delivery of effective missile and artillery fire against suitable enemy targets.

In these remarks, gentlemen, I have sought to lay before you in brief outline the dimensions of the major effort which we of the Army are exerting in the area of modern military science and technology. The Army's R. & D. approach is governed by the classic fields of military concept—mobility, firepower, and communication. In

each of these fields, our troops must be able to out-perform the potential enemy, at any time under any conditions. The Army's program is geared to meet this critical objective and, directly proportional to the availability of the funds to support it, that program is progressing soundly and surely.

In these brief remarks, it has not been possible to fully present all aspects of our diverse program. My deputy, Maj. Gen. Robert J. Wood, next to me, is prepared to go into more detail. I appreciate the privilege of appearing before this committee and I stand ready with all of the personnel and resources at my command to keep you fully informed at all times.

Thank you.

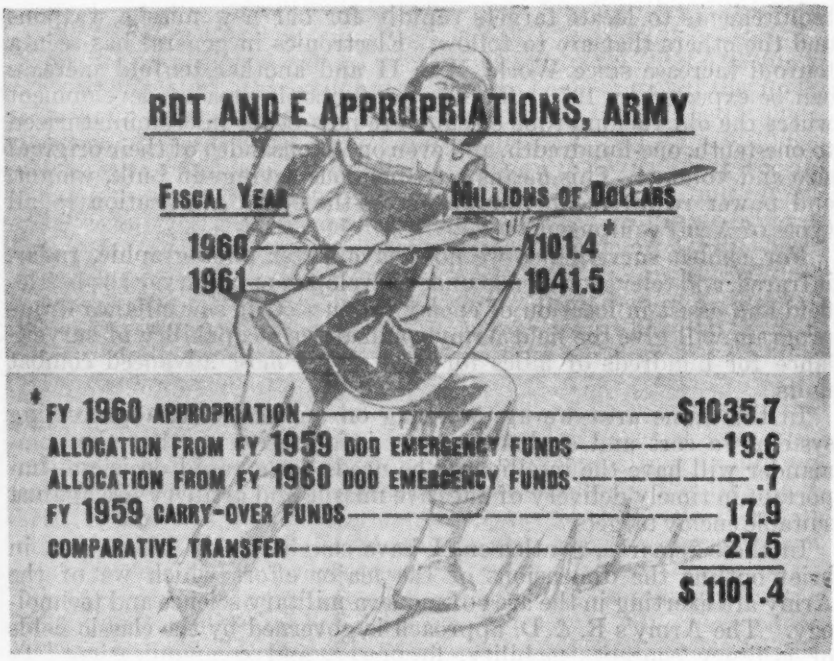
Mr. MAHON. Thank you, General Trudeau, for a very stimulating and helpful statement.

We will now hear from our old friend, General Wood.

GENERAL STATEMENT OF DEPUTY CHIEF OF ARMY RESEARCH AND DEVELOPMENT

General WOOD. Mr. Chairman and members of the committee, I am Maj. Gen. Robert J. Wood, Deputy Chief of Research and Development for the Department of the Army. It is an honor and privilege to appear before you again this year—for the third year—to discuss the Army research and development program. Last year General Trudeau and I described a number of new concepts and projects. Today I shall give you a status report on many of those projects as well as describe some new items.

COMPARISON OF BUDGET

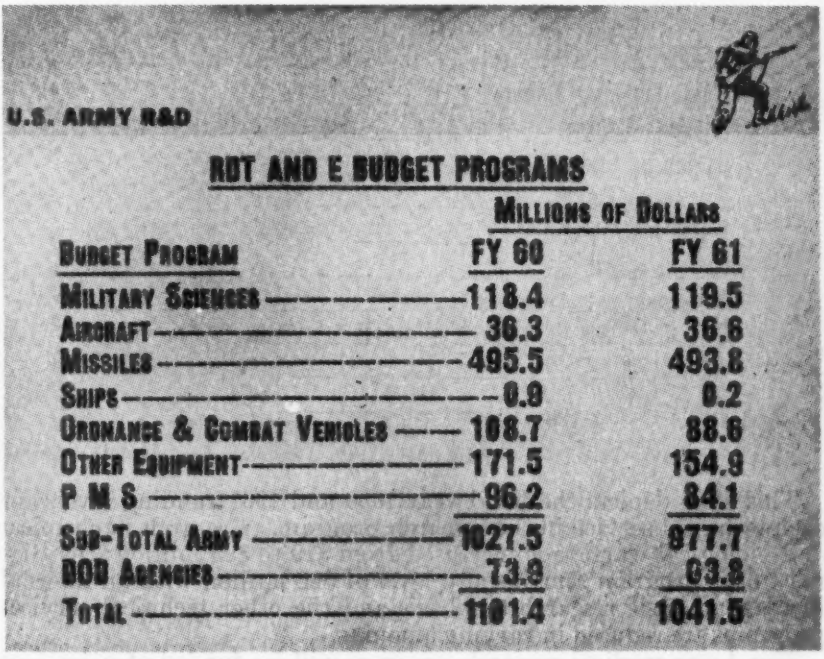

RDT AND E APPROPRIATIONS, ARMY
FISCAL YEAR
MILLIONS OF DOLLARS
1960 1101.4*
1961 1041.5
* FY 1960 APPROPRIATION $1035.7
ALLOCATION FROM FY 1959 DOD EMERGENCY FUNDS 19.6
ALLOCATION FROM FY 1960 DOD EMERGENCY FUNDS .7
FY 1959 CARRY-OVER FUNDS 17.9
COMPARATIVE TRANSFER 27.5
$ 1101.4

This slide shows the dollar level of the fiscal year 1961 R. & D. appropriation as compared with fiscal year 1960. The fiscal year 1961 appropriation of $1,041 million in direct obligations represents approximately 11 percent of the total Army budget. It is $60 million less than the fiscal year 1960 direct obligation program of $1,101 million.

For research, development, test, and evaluation, Army, the Congress appropriated $1,036 million new obligation authority in fiscal year 1960. This chart shows increases totaling $65 million which result in the $1,101 million direct obligations for fiscal year 1960.

These increases are: $19.6 million from fiscal 1959 DOD emergency funds made available on June 30, 1959, and which will be obligated in fiscal year 1960; $0.7 million from fiscal 1960 DOD emergency funds for the Upper Atmosphere Rocket Research Facility at Fort Churchill, Canada; $17.9 million fiscal 1959 carryover funds planned for obligation in fiscal 1960—$12.6 million of this is for DOD agencies; and $5.3 million is for Army activities, and $27.5 million representing a comparative transfer in funds from other appropriations due to transfers of functions in fiscal year 1961 from other appropriations.

BUDGET PROGRAMS



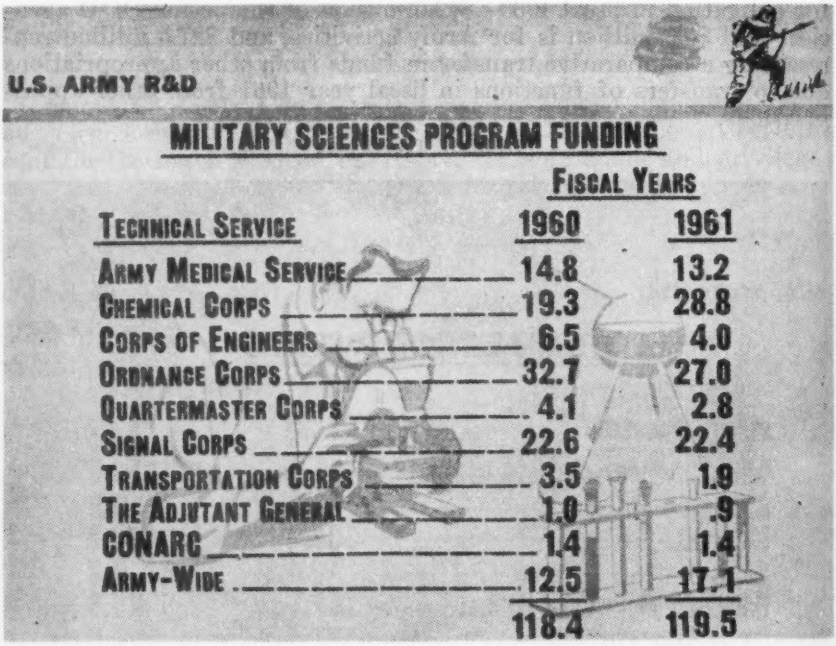
This slide shows the direct obligation funding levels of the budget programs in the R.D.T. & E. appropriation for fiscal years 1960 and 1961. The military sciences, aircraft and missiles programs remain essentially at a constant level while funding for other programs is reduced in fiscal year 1961.

I shall now discuss the progress, funding and the details of each of these budget programs, and significant projects therein.

MILITARY SCIENCES

First, the military sciences program is funded at essentially the same level as in fiscal year 1960: $119 million. This program includes all of the Army's basic and most of the applied research. Supporting research associated with particular development projects is provided for in the programs for those projects and represents an additional effort in research above the $119 million estimated at about $43 million.

Although the overall funding level of the military sciences program in fiscal year 1961 is much the same as last year, some changes in emphasis will take place within the program.



This slide depicts the fiscal year 1960 and 1961 funding levels for each technical service in the research program. Research in chemical and biological warfare is increased from $19 to $29 million; the Signal Corps program remains at a level of $22 million with an internal increase in basic research emphasis and the other technical services programs are reduced in varying amounts.

The Army medical research program will be funded at a level of $13.2 million; $1.6 less than last year. With this funding a broad program of medical research will be continued.

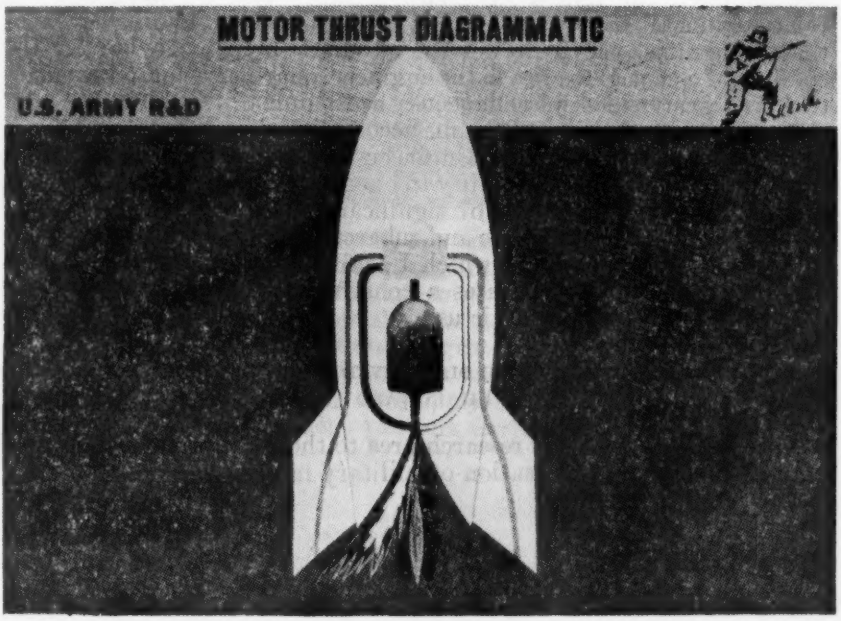
One of the more important projects is the continuance of investigations in infectious diseases with increased emphasis on oversea research in regions of military importance.

An accomplishment of major potential consequence in this area during the past year has to do with the combined treatment and prevention of malaria. Studies using human volunteers have shown that two drugs now in use—primaquine and chloroquine—when administered together in weekly doses not only permanently cure malaria in over 90 percent of the cases treated, but also act as a continuing prophylaxis against infection. This coming year the Army Medical Service will initiate field trials overseas in areas where malaria is endemic.

The Army will continue a program to develop a chemical prophylaxis for radiation exposure. To date about half of the components tested have shown some protective activity for small animals; however, toxicity of the drugs continues to be a major problem so far as human treatment is concerned.

The Ordnance military sciences program will be supported in fiscal year 1961 with $27 million, a reduction of $6 million, spread generally over the Ordnance research program. Ordnance basic research will continue at a slightly higher level than in fiscal year 1960.

PNEUMATIC DEVICES



Ordnance research has made recently a real breakthrough in pneumatic techniques. This slide shows the principle involved in one possible use of a pneumatic system to guide a missile by deflecting the thrust of the motor.

The basic idea is to use a lower energy jet of fluid to impinge on and deflect a high energy jet of fluid. The energy controlled can be 100 times greater than the controlling energy. Use of this principle may permit the construction of pneumatic systems which can perform some functions of electronic computers, such as memory, computa-

tion, and feedback. These systems would have no moving parts and would be rugged and reliable as well as relatively cheap to manufacture. Where little power is required, as in a computer or warhead fuse, a 1-inch cube can perform functions equal to an electronic computer with as many as 300 vacuum tubes. I should add we are just in basic research on the principle, and have asked OSD for emergency funds to pursue its development.

In addition, as part of the overall Defense directed program, Army Ordnance research emphasis this coming year will include:

Research in solid propellants which will contribute to advances in rocket propulsion.

Ballistic research to determine significant aspects of missile performance at speeds exceeding mach 5.

Materials research to develop protection against radiation.

Research in energy sources.

The Army Signal Corps military sciences program will continue to emphasize diversified investigations in electron and solid state physics, in electromagnetism and in electronic components directed toward size and weight reduction and improved reliability performance.

With the exception of the Chemical Corps program which I shall discuss later, the remaining Army military sciences programs are relatively small in terms of funds involved. The funding levels of these programs, which are shown on chart 3, will provide for the conduct of essential studies in the engineer, quartermaster, transportation, and armywide (miscellaneous) areas during fiscal 1961.

An example of the work being accomplished in one of these programs—that of the Corps of Engineers—is the development of techniques which improve our ability to operate in the cold regions of the earth. Such techniques are of significant value to scientific as well as military effort in the arctic and subarctic regions.

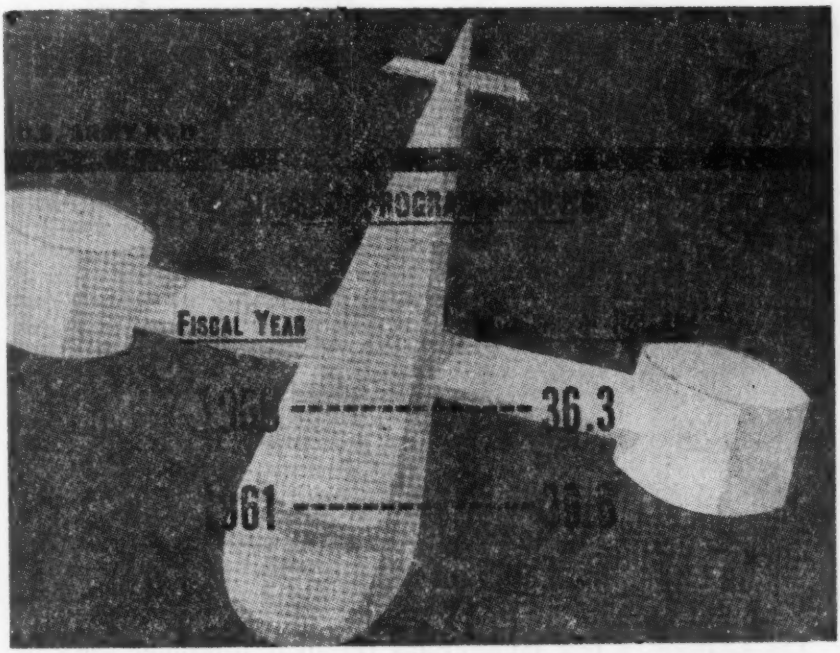
One of the film sequences which I shall show you at the conclusion of this presentation illustrates a construction technique which the Army has developed for arctic use.

PROGRAMS WHICH CONTRIBUTE DIRECTLY TOWARD CREATION OF MILITARY HARDWARE

Turning now from the research area to those programs which contribute directly to the creation of military hardware.

ARMY AVIATION

First, the Army aviation program.

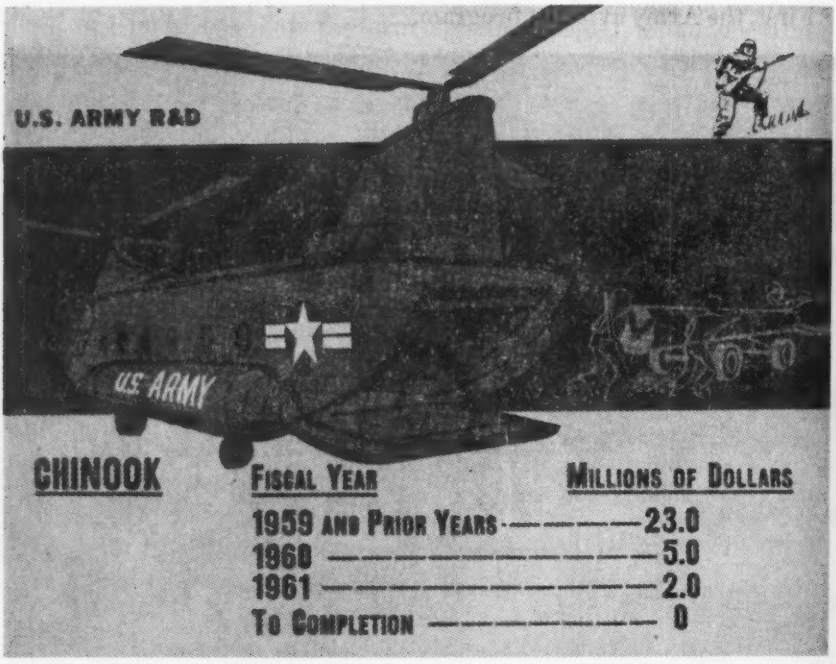


This slide depicts funding levels for fiscal years 1960 and 1961.

General Trudeau has described to you the Army aviation development plan. This plan is a fundamental evaluation of the aviation sciences which is designed to establish a sound basis for a comprehensive, long-range Army aviation program. Our current program, which I shall summarize, may require some revision based upon the outcome of the Army aviation development plan.

Major aircraft development projects currently underway include the following:

CHINOOK



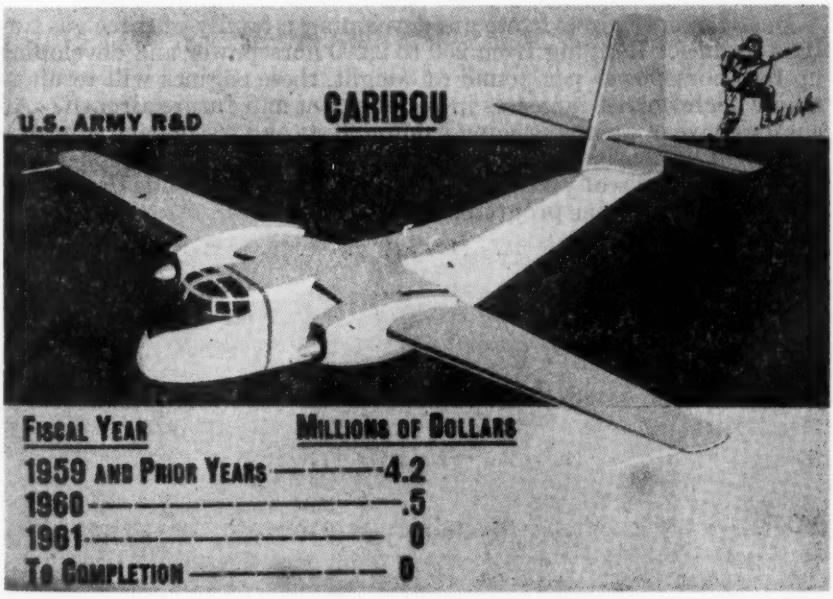
The Chinook, a new multiturbine transport helicopter made by Vertol is designed to transport a 2- to 3-ton payload or 32 combat-equipped troops. It will fulfill most of the functions now performed by three other transport helicopters.

Fiscal year 1961 funds will be used for component development and flight tests. Flight tests of the first developmental aircraft are scheduled for the second quarter of fiscal year 1961 with operational availability planned for fiscal 1963.

MOHAWK

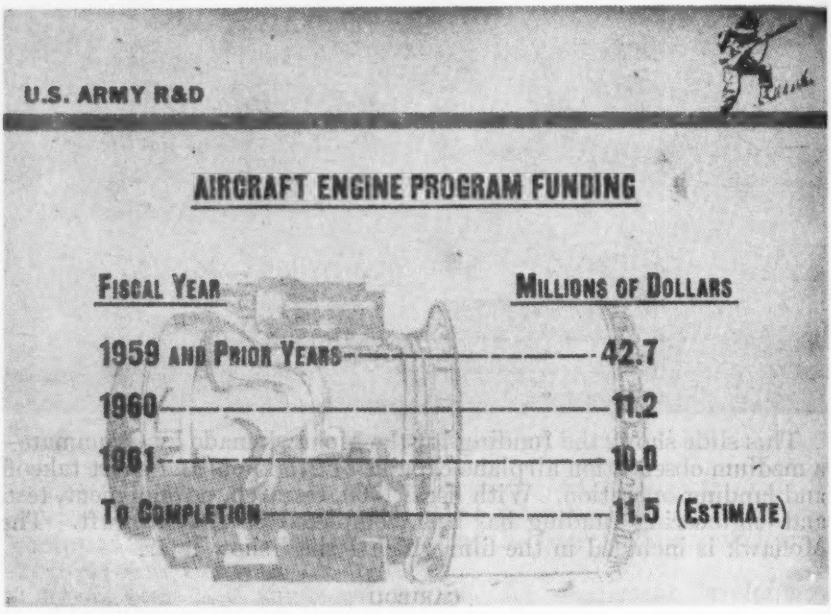
This slide shows the funding for the Mohawk made by Grumman—a medium observation airplane capable of 275 knots and short takeoff and landing operation. With fiscal 1960, research, development, test, and engineering funding has been completed on this aircraft. The Mohawk is included in the film which I shall show later.

CARIBOU



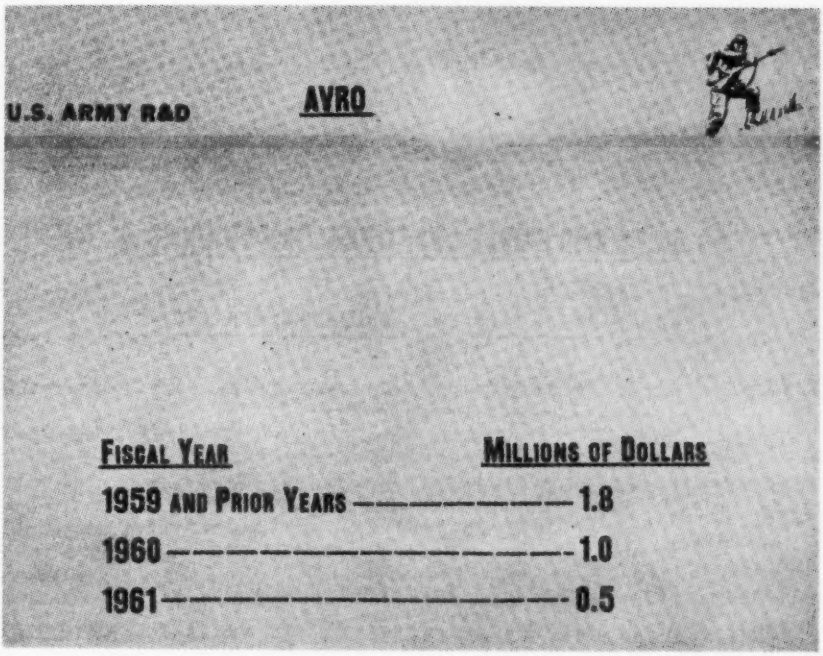
For tactical transport, the short takeoff and landing Caribou is under test. This is the aircraft which, fully loaded, took off and landed on the Fort Myer parade ground last year. With R. & D. funds the Army has purchased 5 aircraft for engineering testing and 22 additional are being procured with PEMA funds from de Havilland of Canada for doctrinal evaluation and user tests. The film presentation will give you an indication of the capabilities of the Caribou.

AIRCRAFT ENGINES



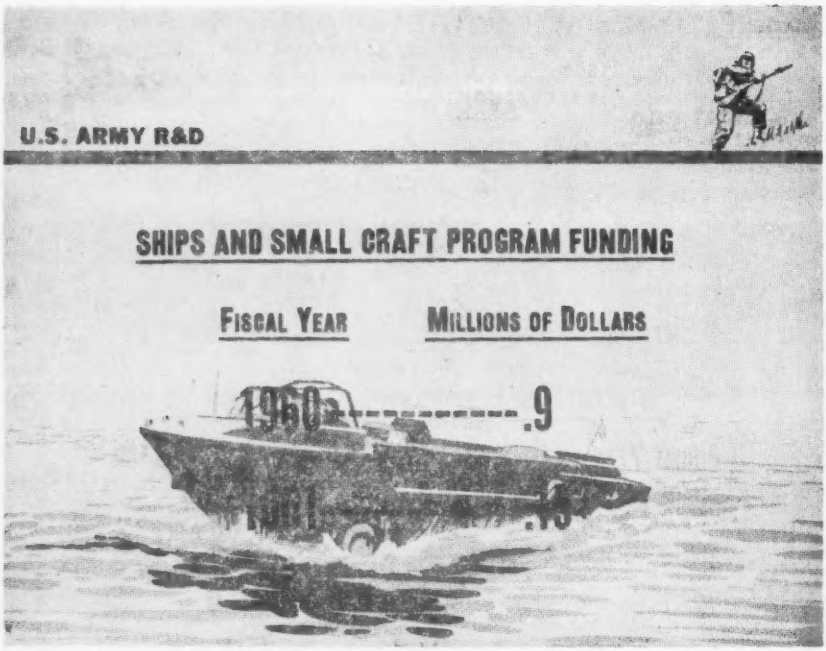
In addition to aircraft, we are developing a family of three gas turbine engines. Ranging from 250 to 2,200 horsepower and developing up to 3 horsepower per pound of weight, these engines will result in major performance increases in both current and future aircraft. All engines have or are undergoing running tests and testing and improvement will be continued this coming year with standardization of one engine in each fiscal year 1960, 1961, and 1962. This slide depicts the funding of the engine program.

AVRO-CAR

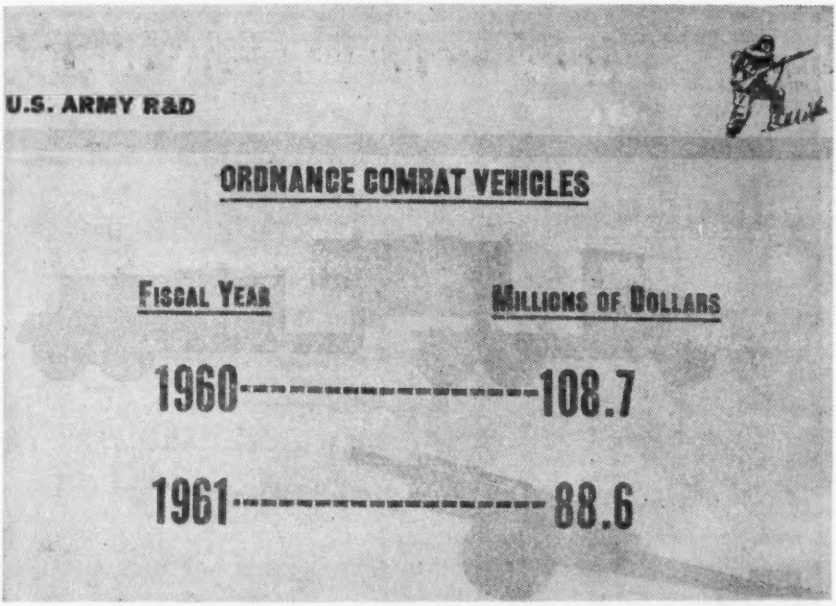


This slide shows the funding for the AVRO-CAR, a test bed aircraft under development by the A. V. Roe Group of Canada.

The AVRO-CAR was first flown in free flight in November of last year and is currently undergoing full scale wind-tunnel tests conducted by the National Aeronautics and Space Administration. This aircraft is to be tested again in free flight before the end of this month.



Skipping missiles for the moment, the next program in the "Research, development, test, and evaluation" appropriation is ships and small craft. This program provides for Transportation Corps development of marine craft and equipment for over-the-beach logistical use. This slide shows program funding. This $150,000 will be used for testing two items: the LARC–15, a 15-ton amphibious lighter, and a turbinized version of the 5-ton lighter.



The ordnance, combat vehicles, and related equipment program includes all weapons, ammunition, mines, rockets, tanks, and artillery normally considered firepower other than missiles. Wheeled vehicles and surface propulsion systems are included also. This slide shows the program funding.

The $20 million reduction in fiscal year 1961 as compared with fiscal year 1960 consists of a $15 million decrease in firepower and a $5 million decrease in vehicles.

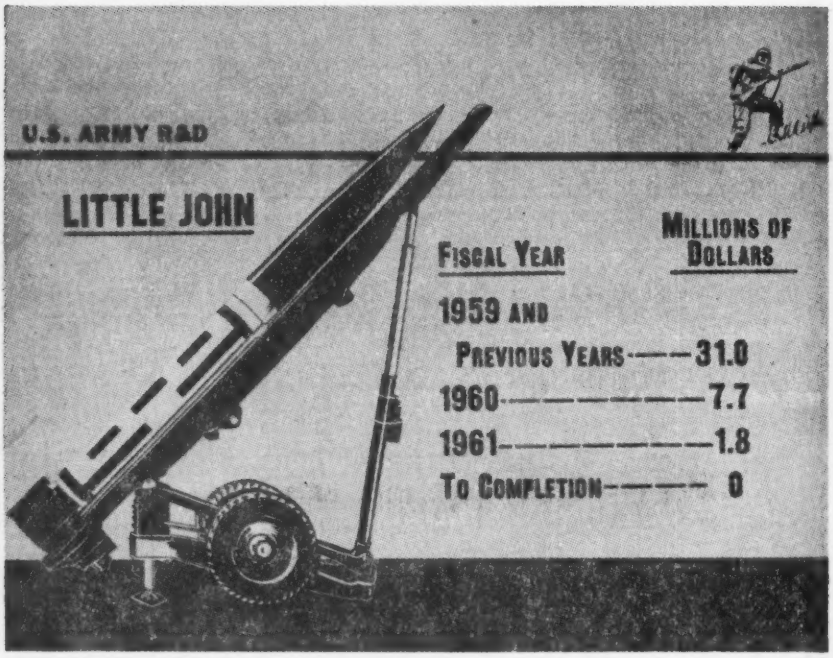
The decrease in firepower funding is attributable primarily to reduced R. & D. requirements for the new 105 millimeter and 155 millimeter self-propelled howitzers and for LITTLE JOHN, VIGILANTE, and the 120-millimeter recoilless rifle as these items near completion of development. Another factor is the successful completion of weapons such as the caliber .50 and 7.62 millimeter tank machine guns.

The $73 million programed for firepower will permit acceptable funding for artillery, tank, and related equipment and small arms research. Chemical and biological munitions development is accelerated.

The $5 million decrease in vehicles and propulsion systems results primarily from deletion of special logistical transportation equipment; reduction in requirements for the air-transportable, armored personnel carrier family and deferral of effort in certain areas of armor investigation.

The $15 million planned for vehicles and related equipment will permit scheduled testing of the GOER, continued work on the wheeled vehicle family, and continued development of propulsion systems.

LITTLE JOHN

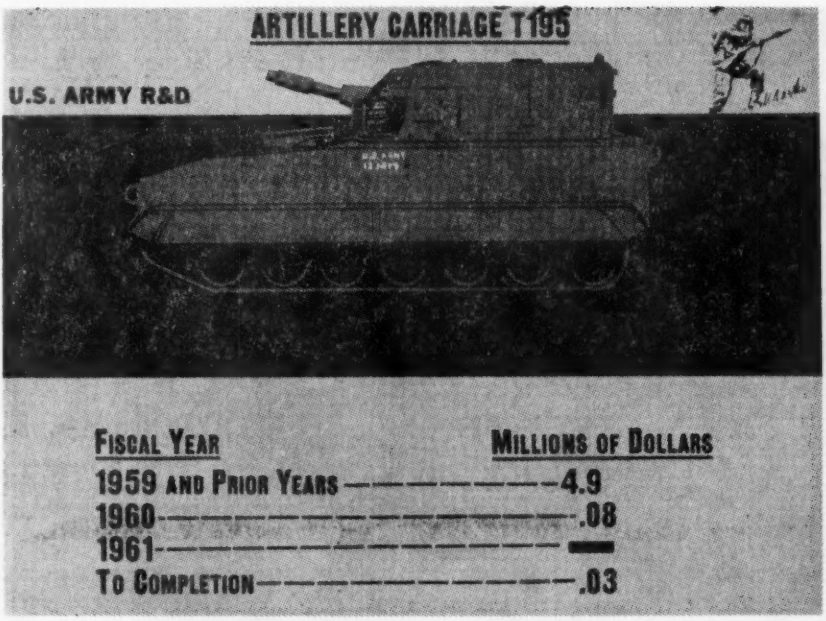


In the rocket area, we are improving the LITTLE JOHN. This project is funded for $1.8 million in fiscal year 1961. LITTLE JOHN is a lightweight rocket which will replace HONEST JOHN in air-transported units. It can be delivered by parachute or helicopter and towed by a jeep.

The film will show LITTLE JOHN in a firing sequence and using helicopter transportation.

Significant progress has been made during the past year in the Army's new self-propelled artillery family.

ARTILLERY CARRIAGE

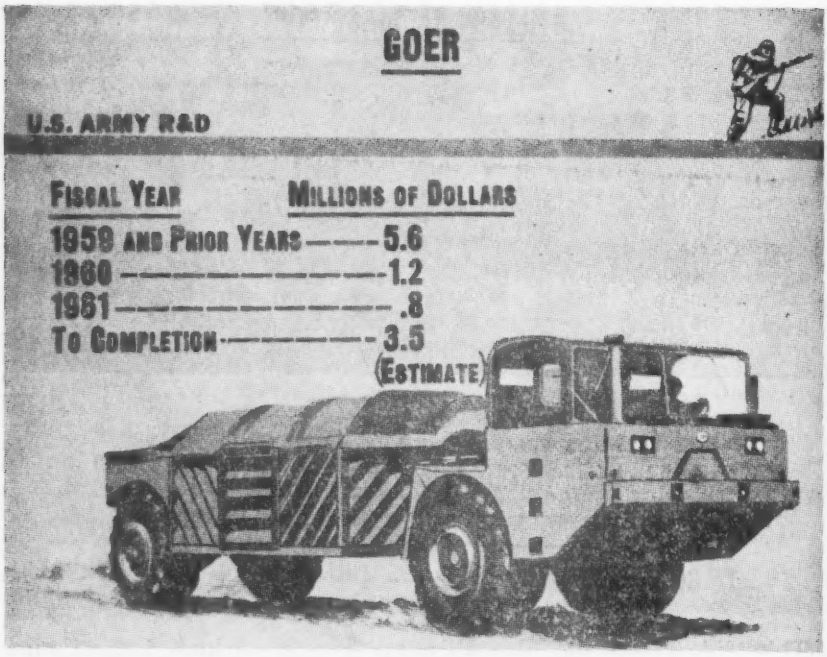


This slide shows the 105-millimeter howitzer which I mentioned earlier, on its aluminum armored carriage. This carriage, which is amphibious, weighs 19 tons, which is 8 tons less than the steel carriage now in service. This same carriage will also mount the 155-millimeter howitzer. Another carriage is in development which will mount either the 8-inch howitzer, the 155-millimeter gun or the new 175-millimeter gun. The latter outranges all known Soviet artillery pieces. All the self-propelled family will have lower initial costs, less weight, and greater operating range, reliability and cross-country mobility than comparable weapons now in use. All of these items are now in user-test with standardization scheduled for late this calendar year.

In addition to the weapons themselves, the Army is pursuing several promising approaches to increase the lethality of artillery ammunition.

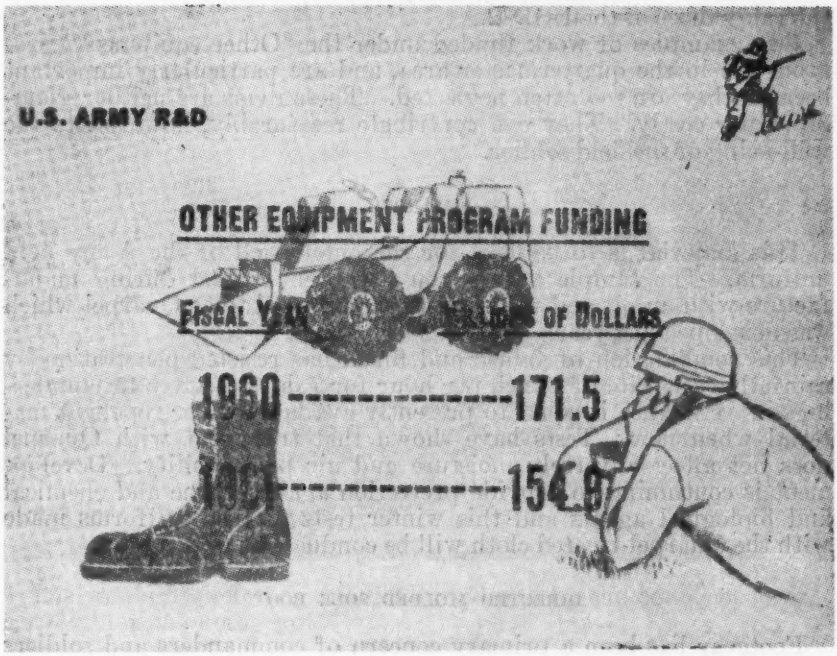
DAVY CROCKETT

During the past year the Army has made significant progress in the development of DAVY CROCKETT. This is the lightweight, highly mobile man-portable weapon system which will provide nuclear firepower for the support of small tactical units.



In the logistics mobility area, the GOER program, which General Trudeau mentioned, offers a great potential at a very low R. & D. cost. This program is on schedule with testing of prototype vehicles which were constructed with commercially available parts. The film to be shown later indicates the capabilities of the GOER.

OTHER EQUIPMENT



We turn now to the budget program "Other equipment." This program is funded with $155 million in fiscal 1961, $16 million less than the previous year. It includes a wide variety of projects ranging from communications and electronics to food and clothing. Some of the trends in this program include:

An increase in chemical and biological warning, protection and detection.

A continued level of effort in mine warfare, night vision, mapping and geodesy and electrical power.

Increased effort in radio and wire communications systems and security equipment.

Increased effort in aerial surveillance and photography, while ground based radar and other sensory devices have reached their peak of research, development, test, and evaluation funding and are reduced.

COMBAT SURVEILLANCE

Let me give you now a brief status report on the cambat surveillance program. This drone—the USD–2—was described to you by General Colglazier. The USD–2 has been selected as the Army's first operational surveillance drone system and the fiscal year 1961 budget includes funds for its procurement.

These models illustrate the other two items in our family of drones. This is the USD–4, a medium endurance drone for use in corps surveillance; and this is the long endurance USD–5 which will be used to meet field Army surveillance requirements and engineer tactical mapping needs.

Both drones will employ photo, infrared and radar surveillance devices, as does the USD–2; however, their capabilities will exceed considerably those of the USD–2.

Two examples of work funded under the "Other equipment" program are in the quartermaster area, and are particularly important because they are too often neglected. These items are neither glamorous nor costly. They can contribute measurably, however, to the well-being of the field soldier.

QUARPEL

This material is to be used for the outer shell of the Army field uniform. The sample before you has been treated during manufacture with an oil and water repellent referred to as Quarpel which was developed last year.

This combination of fabric and finish has resisted penetration by rainfall at the rate of 1 inch per hour for 7 days. After 15 launderings its resistance is equal to presently available water repellent material when new. Tests have shown that treatment with Quarpel does not affect adversely moisture and air permeability. Development is continuing to provide protection against flame and chemical and biological agents and this winter tests of field uniforms made with the Quarpel-treated cloth will be conducted.

DIRECTED MOLDED SOLE BOOT

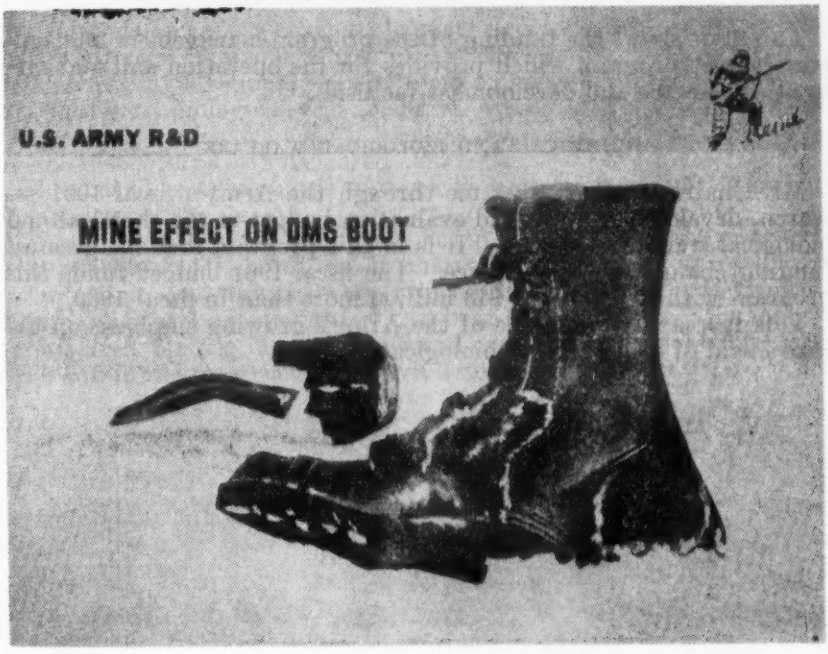
Footgear has been a primary concern of commanders and soldiers alike since the beginning of warfare. Perhaps a completely ideal solution to the problems of military footwear is beyond realization, but the Army is continuing to search for improvement.

During the Korean war, Army teams investigating the effect of mines observed that the rubber insulated boot provided much more protection against antipersonnel mines than the leather combat boot. This led eventually to development of the new combat boot which I have here.

This boot features a rubber sole and heel welded directly to the upper and is lighter in weight than the present combat boot. Extending under the heel and arch is a stainless steel shank designed to protect the foot against the effects of antipersonnel mines.

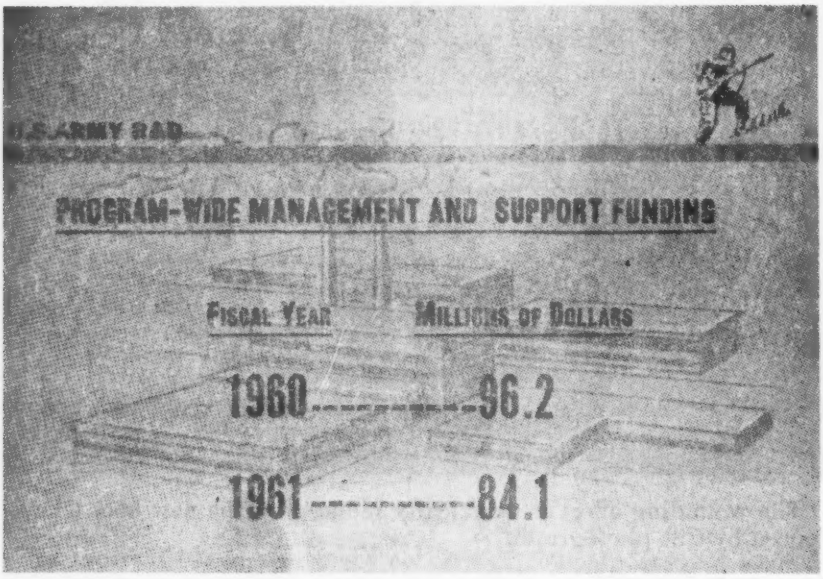
This photograph illustrates the effects of a standard antipersonnel mine when the present combat boot is worn.

The wounding effect is drastically reduced by the new boot as evidenced by this photograph.



This boot has been field tested, including use on a 100-mile hike, with excellent results.

PROGRAM MANAGEMENT AND SUPPORT

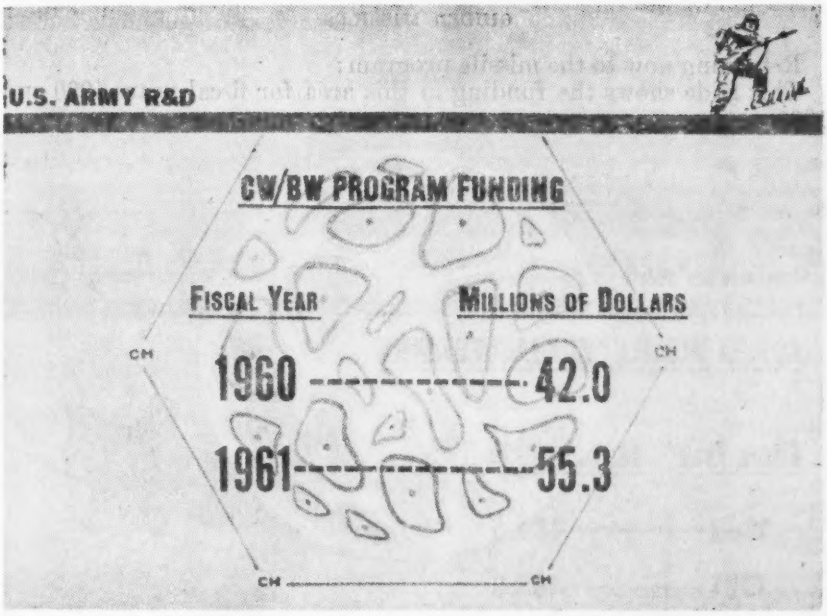


This slide shows the funding of the program management and support budget program which provides for the operation and management of research and development facilities.

CHEMICAL AND BIOLOGICAL WARFARE

Mr. Chairman, that takes me through the Army's fiscal 1961 research, development, test, and evaluation budget to the chemical and biological warfare program. It is in this program that the greatest funding change has taken place. The fiscal 1961 budget funds this program with $55 million; $13 million more than in fiscal 1960.

This increase is indicative of the Army's growing emphasis on the entire field of chemical and biological weapons.



The broad objectives of the program are to develop defensive systems which will enable the Army to fight effectively under chemical and biological warfare conditions, to exploit development of incapacitating agents, and to develop chemical and biological weapons systems which can complement the nuclear deterrent.

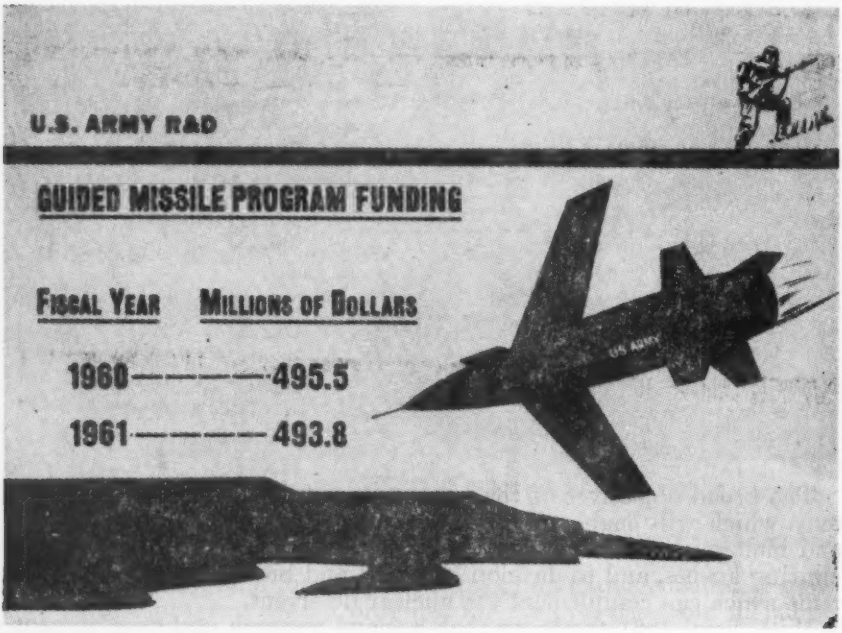
With fiscal 1961 funds we shall expand research and development pertaining to biological and chemical agents and methods of dissemination. Defensive aspects such as detection, warning, and protection also will receive increased emphasis.

This board is an example of work in protection against chemical and biological agents.

This material is called diffusion board. It is similar to ordinary fiber board with the addition of charcoal and other substances. It permits air to pass inward while filtering out biological and chemical agents. About 1 square yard of this board will supply all the usable air required for one man. This board can be used in field fortifications and in the construction of civil defense shelters.

Returning now to the missile program:

This slide shows the funding in this area for fiscal years 1960 and 1961.

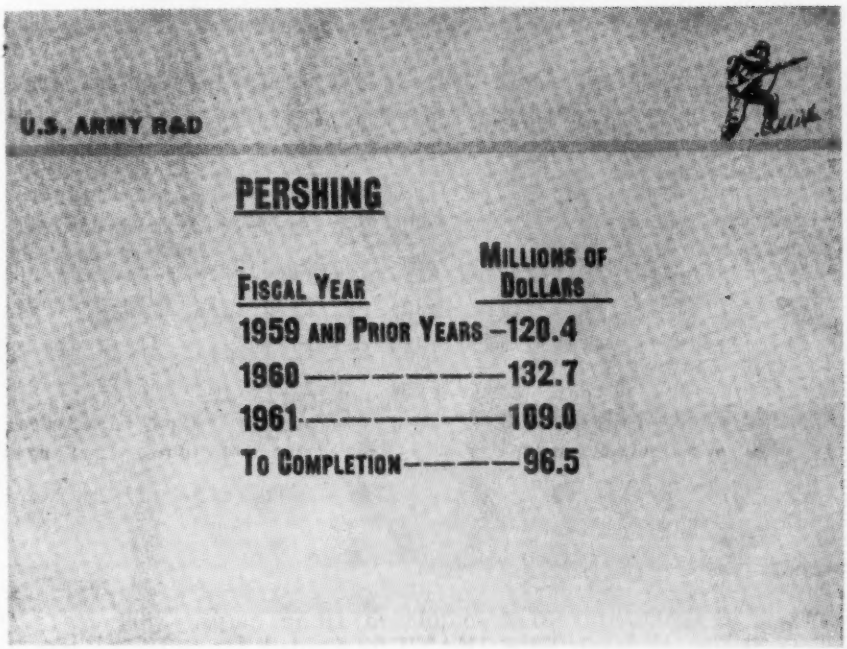


This program will be funded in fiscal year 1961 with $494 million, essentially the same as that planned for fiscal 1960. Of the fiscal 1961 amount, $396 million—80 percent—reflects the cost of two missiles; $287 for NIKE-ZEUS and $109 million for PERSHING.

The Army's missile development program contains three missiles in the surface-to-surface field and five in the surface-to-air field.

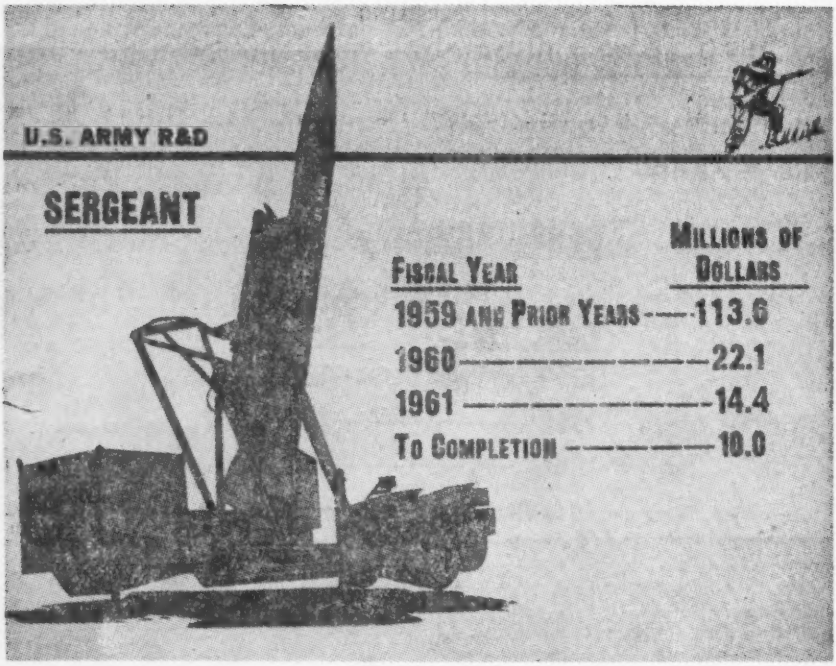
In the surface-to-surface field:

PERSHING



In surface-to-surface this slide depicts the funding for PERSHING—you will note that the peak of R.D.T. & E. funding has been passed. Development of PERSHING continues on schedule. It will provide a solid propellant all inertial guided missile replacement for REDSTONE as the field Army support missile. The first firing of this missile took place last month, right on schedule.

SERGEANT



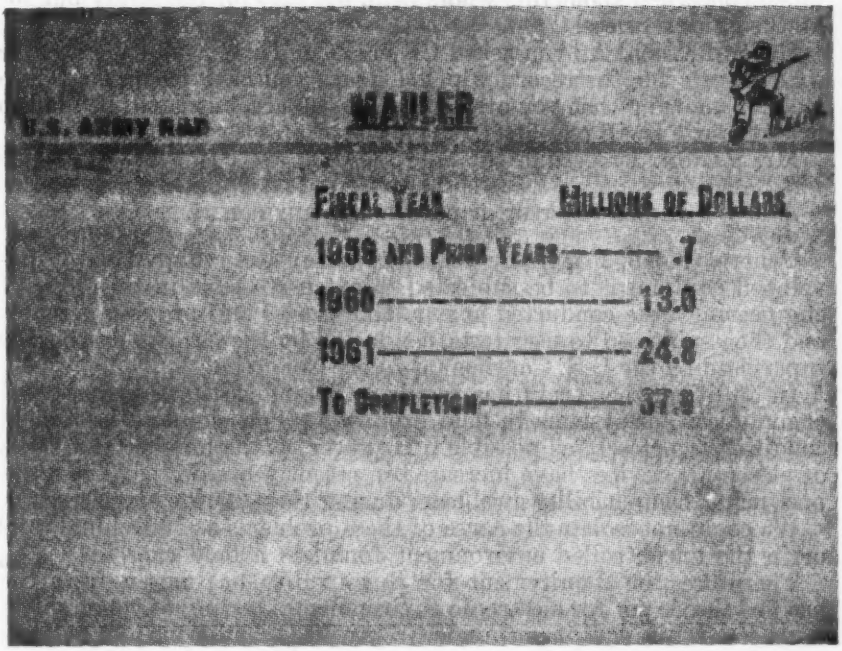
At the corps level, SERGEANT is funded for $14.4 million in fiscal 1961. SERGEANT will be much simpler and more rugged and reliable than CORPORAL which it will replace for support of the corps. The film will show a test firing of a SERGEANT missile.

SURFACE-TO-AIR MISSILES

In the Air Defense field, excluding NIKE-ZEUS, Army effort in fiscal year 1961 is oriented toward protection of the field Army.

General Colglazier has described the REDEYE which enters procurement in fiscal year 1961. This weapon will give the individual front-line soldier a powerful means of keeping low-flying aircraft off his back.

MAULER



Another weapon under development for protection of the field Army is MAULER. MAULER is a highly mobile, self-propelled, guided missile system to provide air defense of forward mobile combat elements against short-range ballistic missiles and against rockets and low-flying aircraft. $24.8 million is proposed for MAULER in fiscal 1961.

Mr. Chairman and members of the committee, I shall conclude my presentation with a film which illustrates some of the projects to which I have referred in this presentation.

After the film we shall stand ready to respond to your questions.

(A film was shown.)

General Wood. Mr. Chairman, this completes the presentation which I had.

However, there were three items which either you or other members of the committee raised during previous Army hearings. One is the aerial crane; one is the electronic environment test facility at Fort Huachuca; and the other was IFF.

I have papers on all three of these items and I am prepared to present them now, if you desire, or we can go into your questions.

Mr. Mahon. You are doing such a good job, I think you should continue.

ELECTRONIC ENVIRONMENTAL TEST FACILITY

General Wood. You will recall, Mr. Chairman, that you raised the subject of the electronic environmental test facility at Fort Huachuca.

Mr. MAHON. We raised that with a lot of people and we are very much concerned about this whole field, not just for the Army but for all the other services.

General WOOD. As you asked General Colglazier, we sent you over some inserts for the record which I doubt you have had a chance to look at, knowing that you are as busy as you are, but I will be glad to brief those. I will read it, if I may.

Mr. MAHON. Proceed.

NEED FOR TEST OF ELECTRONIC ENVIRONMENT

General WOOD. For many years the Army has required newly developed equipment to be subjected to extensive tests in the form of engineering tests conducted at our laboratories and proving grounds and then subjected to user tests, conducted by the Army's test boards supervised by the U.S. Continental Army Command.

In addition, the Army has regularly assembled its electronic and communications systems in field exercises which simulate battlefield conditions as closely as possible. However, as the number and types of electronic devices have increased in recent years, we have been experiencing compatibility problems during these major exercises.

We could not isolate the cause of these problems by individual tests or in the uncontrolled environment found in a field exercise.

Therefore, the requirement for this facility has arisen from the need of the Army for electronic environmental testing of communications-electronic equipment under controlled conditions. We know that if we go to war today, an Army corps will have about 23,000 electromagnetic emission devices in a square 60 miles on a side, whereas there were something like 9,000 such devices in use in 1948 in the same area.

This program will create a field laboratory which will determine the incompatibility among existing equipments. It will acquire data on which to base specific recommendations for modification of equipment to reduce interference. It will provide the basis for the establishment of standards and specifications to limit interference in future development; and will test frequency allocation plans and operational concepts under controlled conditions.

Newly developed equipment will be tested in a realistic electromagnetic environment prior to standardization. Also, it will provide a range for engineering and operational testing of surveillance devices and systems.

The environment, when in operation, will be a vital training ground for signal, electronic warfare, and Army Security Agency units for coping with the problems which combat troops will face in this area on the future battlefield. Through this effort, the battlefield commander will be assured that his command control, which means his communications capabilities, and surveillance equipment, will operate properly in any and all electromagnetic situations.

CONTRACTING FOR OPERATION OF FACILITY

It was determined that the problem was of such magnitude and complexity that a major contractual effort would be necessary to install and operate such a facility under the management, supervision, and control of the U.S. Army.

Accordingly, a meeting was held in Tucson, Ariz., in January 1959 to acquaint industry with the Army's requirements. This meeting was attended by approximately 400 individuals representing more than 130 different concerns. At this time the intent of the Army to solicit proposals for this program was disclosed with the details as to the requirement.

A request for quotation was issued in July 1959 to all concerns which had indicated an interest in submitting a proposal. The solicitation went to 127 companies of which 80 were large business and 47 small business.

A prebidders conference was held July 27, 1959, in Tucson, Ariz., to permit industry to query the Army as to any points not clear.

At this time it was disclosed that this procurement would be made by means of a two-phase method. The first phase would consist of the submission of technical proposals without pricing and their evaluation to insure that the proposals were technically acceptable.

Bidders were advised that the technical evaluation of their submissions would be utilized to reduce the number of bidders to those concerns whose offers were considered most advantageous to the Government from a technical standpoint. Twelve technical proposals were received by August 31, 1959. The concerns submitting these proposals were identified in the material which has been forwarded to the committee.

The 12 proposals were submitted by the contracting officer for technical evaluation to an evaluation panel established by the Chief Signal Officer of the Army. The evaluation by this panel resulted in the conclusion that four proposals were considered sufficiently high in technical quality to warrant consideration in phase two. The concerns which submitted these four proposals were also identified in the material forwarded to the committee.

Full and free price negotiations were then conducted with these four concerns and with their proposed subcontractors by military teams representing the Chief Signal Officer to insure a complete understanding of each proposal.

After thorough negotiations, cost and price analyses, and reexamination of the technical aspects of these four proposals, the recommendations of the Chief Signal Officer were forwarded to the Army Staff for final processing and decision by the Secretary of the Army.

This program is so designed that the contractor will not, himself, evaluate equipment in the operation of this facility or determine the equipment to be tested. The contractor will be charged with installing testing equipment and the conduct of testing operations.

The equipment to be tested in the initial phases will be standard items of equipment available in the Army inventory, plus new items beginning to emerge from the development program, which are suitable for the conduct of field engineering tests.

During the course of the tests, the contractor, under supervision of the Army, will collect the necessary data, reduce them to manageable proportions, and deliver them to the military authorities at Fort Huachuca.

The final analysis of the data, the evaluation of the test, and the determination of the suitability of the tested equipment for inclusion

in the Army inventory will be the responsibility of the Army and not the contractor.

The Army will direct and control the manner in which the contractor prosecutes this contract.

A team of military and civilian personnel from the U.S. Army Electronic Proving Ground will be directly controlling, reviewing, directing, and approving the performance of the work.

This is not a management type contract. It requires skills for devising, fabricating, installing, and operating a test facility.

The Army feels that this facility is a most urgently needed proving device which will obviate the development and introduction of equipment into a battlefield environment where it may not function and which will save critically short research and development funds needed for the defense effort. It has the full support of the Director of Research and Engineering in the Office of the Secretary of Defense.

As I think I told you before, sir, as to funding there are $1.3 million of fiscal year 1959 funds carried into fiscal year 1960 where we have $12.6 million, or a total of $13.9 million in 1960 money. We desire to go into a 2-year program and we have $8.68 million in the budget that is before you.

Have I answered your questions or do you want anything else?

Mr. MAHON. Thank you. You have done a good job in giving us your views on this.

Have you let the contract?

General WOOD. No, sir. The Secretary of the Army had a presentation which I attended last week. So far as I know, he has not made a decision. When he does, as you know, we have a standard operating procedure that any Congressman who has shown an interest will be notified.

Mr. MAHON. I do not know of anybody on this subcommittee who has any interest in contracting, as such, or the companies, as such. Of course, we would be interested in the report of the Commission with regard to that.

General WOOD. I was trying to clarify the point.

Mr. MAHON. Did the Chief Signal Officer make his selection? Has he made his selection and recommendation?

General WOOD. The Chief Signal Officer made an evaluation which ended up with the four companies and then went into a price negotiation phase, which is the normal contract procedure. Then he presented all of this to the Secretary of the Army, including the 12 first bids, and their technical evaluation, so far as he was concerned, and the price evaluations.

The Secretary of the Army said at that meeting which I attended, "I will let you know what my decision is."

Mr. MAHON. I guess the Chief Signal Officer has given the Secretary of the Army guidance as to who should be selected?

General WOOD. He gave him the points which he thought had emerged from his evaluation, technical and costwise.

Mr. SHEPPARD. You said the committee was not interested. They are interested in this research and development money so long as it is flowing through what we call construction channels. I am referring to the brick and mortar aspect, not electronics, the Army Engineers and their counterparts in the Navy. To that degree, we have a vital interest.

You have already stated this is being handled through the Army Engineers from a construction civilian point of view?

General WOOD. Signal Corps.

Mr. SHEPPARD. Who is building it for you?

General WOOD. The building, if there is any building to be built, naturally will be built by the Engineers.

Mr. SHEPPARD. That is the point I was making.

General WOOD. Essentially this facility will consist of communications and equipment located at points around this area.

Mr. SHEPPARD. I understand that perfectly.

Mr. MAHON. I thought for a moment that the implication of your statement was that some of us might be interested in individual contracts or contractors. I now understand your statement. We, of course, have no concern except for our official duty. We want to promote defense and safeguard taxpayers dollars.

General WOOD. The legislative liaison office does that automatically on any contract that any Congressman has written in and said he was interested in. For example, in this case I know that some of the Congressmen from Arizona have been interested and want to know when this contract is going to be awarded and who is going to get it.

General TRUDEAU. I would like to add that this project has been carefully followed by me personally since it was first initiated. That is, since the proposal was first initiated in 1958. We have reduced it to what we consider the irreducible minimum for starting these tests. When the Chief Signal Officer made his recommendation, it was not only presented in detail to me, but also the entire method of evaluation was reviewed by me. A technical recommendation was made to the Secretary in connection with the letting of this contract and the Assistant Secretary of the Army for Logistics had his Office make a legal determination with respect to the legal aspects of the contract.

It is now in the Secretary's hands, as General Wood said.

To put this in its simplest terms, gentlemen, General Wood has brought out the problems that may exist with respect to the compatibility of all of the tremendous number of electronic emissions that go in any particular area.

I might give you an analogy. This would be like ordering musicians with every instrument in the world to put on a presentation in the Opera House in New York City without any rehearsal. I do not think it would be very acceptable since the payoff in our work is going to be on the battlefield and we feel we have to know how the harmonics, if I may use that term, of all of these electronic emissions are going to work out. That is what we are trying to do.

METHOD OF TESTING

Mr. MAHON. I am amazed you have not gone into this much earlier and with greater vigor. It seems to me that this is more important than it has apparently been considered heretofore.

General TRUDEAU. One of the problems has been to bring the total cost of the effort down to something we thought was within the ballpark, as we frequently say. We have done that to the best of our ability.

Mr. SHEPPARD. As I interpret this testing operation, and I might have a misconception of it, you actually are testing out the components for the express purpose of knowing exactly what is going to happen to the best that you can under testing proclivities, operationally speaking. By that determination, you are obviously going to be able to cut down your unnecessary spare parts right from the inception, are you not?

General TRUDEAU. I do not know about the inception, but we do hope so.

Mr. SHEPPARD. You are not going to have a lot of stuff piled up you have already proved in your testing category is no good?

General TRUDEAU. That is correct.

Mr. SHEPPARD. You have a dual operation and purpose there, as I interpret this.

General TRUDEAU. We are trying to test an Army outfit against a simulated enemy outfit, including jamming, interference, and what it does with respect to, let us say, commercial television and radio in nearby cities, and what it does in connection with airplanes that might be flying overhead, either military or commercial.

This is a very important effort on our part.

Mr. MAHON. The Air Force indicated that this was too complex to be handled in the manner in which the Army is undertaking to handle it. The Air Force was in no way critical of the Army, but I got the implication that probably the Air Force problem was somewhat different.

General TRUDEAU. It is quite different.

Mr. MAHON. The Air Force is considering a heavy use of computers and I suppose you will use computers, too, and all other kinds of devices in addition to other things.

Is there any comment you might desire to make on that that might be helpful?

General TRUDEAU. No; except that I think our problem is quite separate and distinct from that of the Air Force.

There are interrelationships with all of the electronic communications that go on the air.

Mr. MAHON. In the event of war, we want to have complete unification and coordination between the services and not have the equipment of one service interfere with that of another.

General TRUDEAU. This will be taken care of.

Mr. MAHON. I assume you are working in that field?

General TRUDEAU. Yes.

Mr. MAHON. I believe you had other presentations or have you finished?

Mr. ANDREWS. May I ask one question before you get away from that?

Mr. MAHON. Yes.

Mr. ANDREWS. General, will the contractors be expected to install the equipment and operate it?

General WOOD. It is an installation and operation type thing.

Mr. ANDREWS. Will you have two separate contracts, or one; one for the installation and another for the operation?

General WOOD. No, sir; one. It was put out on that basis.

COST OF CONTRACT

Mr. ANDREWS. Could you give us some idea as to what the cost will be for that contract?

General WOOD. We have a total of $13.9 million of 1960 money and $8.7 million of 1961 money, for a total of about $22 million.

We have aimed at being under that in evaluating contract proposals.

Mr. ANDREWS. How long will a contract continue for operation?

General WOOD. This is a 2-year plan. We contemplate that the facility will have an indefinite time of operation, and there will be funding in next year's budget which will be something less than either one of these 2 years, because installation is not involved. I do not have an estimate for that at the moment.

Mr. FLOOD. I am intrigued by that last phrase, "the harmonics of electronics." That should appeal to Mr. Leonard Bernstein.

Have you consulted the maestro on this?

General TRUDEAU. No.

Mr. FLOOD. I am sure it would intrigue him. Mr. Bernstein superimposes these physics of music on everything. He takes physical structures and imposes on them musical terminology by analogy. A fascinating performance. He speaks about the visceral reactions which produce methods of techniques.

Here is a whole new field for the great Bernstein, "harmonics of electronics." He can talk rings around you.

Is this one of your brain children?

General TRUDEAU. Yes, sir; I was trying to make a simple analogy understandable to the layman.

Mr. FLOOD. I am not sure about the layman, but Mr. Mahon and I understand it—we hope.

Mr. MAHON. We will recess at this time until 2 o'clock.

AFTERNOON SESSION

Mr. MAHON. I suggest we continue with your presentation, General Wood. You had a couple more things having to do with previous testimony which you were going to highlight at this time, I believe.

IDENTIFICATION, FRIEND OR FOE

General WOOD. Yes, sir. You raised the question of IFF—identification, friend or foe—what was it and where was it, essentially.

As I mentioned during our previous discussion, missiles themselves do not have a capability of distinguishing between friendly and unfriendly aircraft. Friendly aircraft may be identified, however, by a separate electronic system called IFF—identification, friend or foe. These IFF systems are normally auxiliary to an air defense search or weapons acquisition radar and provide, in essence, an electronic method of "challenge" and "password" to permit identification of the aircraft. With present techniques, these systems require equipment in the aircraft as well as on the ground. The challenge is transmitted as a radio signal from the ground to the aircraft which receives this interrogation and then automatically transmits back the proper password signal. Such IFF systems for the identification of friendly air-

craft are well known and were used operationally as early as World War II.

The present IFF system in operational use, although extremely useful, does not have a great deal of security designed into it. In other words, it would be possible for a properly equipped enemy to detect, decode, and imitate its signal. It has been necessary to supplement this system by such devices as prearranged maneuvers, flight plan correlation, use of corridors for friendly aircraft, prearranged code words, et cetra.

It is apparent that this problem of aircraft identification is a matter of concern to all of the services. The development program for a more foolproof IFF system than the present one is now in progress as a joint Army, Navy, and Air Force project. This is an accelerated program which has been jointly funded by the three services and which is proceeding under the executive management of the Air Force. This new IFF system that is being developed differs from previous systems in that it uses ———.

The operational test and evaluation of the new system will be carried out by a joint services test force. The tests will involve the use of radar and aircraft from each of the services.

I might say that the funding, so far as the Army is concerned, for fiscal year 1960 is $1.5 million. However, the total overall funding in the Department of Defense for the air-by-ground portion of the Mark XII program is ——— which indicates to you how much effort is being put into it although the Army contribution is not great. That, essentially, is the status, Mr. Chairman, at the present time.

AERIAL CRANE

The aerial crane, Mr. Chairman, is a problem research and development people have given a lot of thought to, but one which has not yet been solved. I might add that we have not been inactive in the field.

Basically, the Army considers it has a requirement for a device which is capable of moving large loads such as tanks and missile systems over obstacles on the future battlefield. Investigations have shown that the helicopter is the most efficient vertical lift machine available for the immediate future. Therefore, the Army envisions the design of a large external-lift type helicopter—rather than internal loading—which could carry payloads up to 12 tons for distances of 20 miles.

In fiscal year 1957 and fiscal year 1958 several design studies were conducted by industry of flying crane helicopters for the Army. These studies showed that the use of rotor blade tip propulsion would be far superior to systems utilizing conventional shaft and gear drive to the rotor hub. As a result, the Army is sponsoring further development of tip propulsion systems in order to solve the aerodynamic and mechanical problems involved.

The Army has also investigated the feasibility of developing a multi-helicopter system using several helicopters lifting a frame from which heavy loads could be suspended. For the present, this approach does not appear to warrant further development.

At the present time the flying crane has a low development priority in relation to other important aviation projects because of the requirement for only a limited number of these machines and the great

cost involved in developing them (estimated $50 million for first prototype).

In fiscal year 1963 the Army will introduce the Chinook helicopter into the inventory. This will provide an interim heavy lift capability of moving 8 tons externally for a distance of 20 miles. For the longer range future the Army will continue research—and research only at this time—towards the design of a suitable flying crane to satisfy its heavy lift requirements.

The Army has tested conventional helicopters for lifting heavy loads externally, and the commercial concerns have several times come up with ideas of their own. In this connection, one commercial concern has a machine under development which can lift only slightly more than the 8 tons which the Chinook will be able to lift, and for that reason we have not been interested in going into it, although I understand some of our European allies are interested.

That is the situation for the moment. The money spent in this over the past 3 years has totaled roughly $500,000. There is no money specifically in the 1961 budget for this project.

That concludes all I had in the way of presentation.

VALUE OF R. & D. PROJECTS

Mr. MAHON. We will have a period of general interrogation beginning at this point. At the beginning of the hearing this morning I hazarded the statement that probably some crimes had been committed in the name of research and development. I was harking back to the time a few years ago when, in an effort to stimulate a better job in research and development and in an effort to compel the services to eliminate programs of very doubtful value, we made a reduction in this committee, I believe, of 1 or 2 percent in research and development funds.

I know at that time some studies were being carried on which seemed a bit ridiculous. I hasten to add that things which may on the surface seem ridiculous may not be as ridiculous when you look into them. I believe one of the services was having an elaborate study made of sleep and some other things of that type. A number of rather ridiculous things were brought into the picture. Of course, sleep is an important factor in and out of the Department of Defense as far as that is concerned and has military applications.

I would hasten to say that while research and development has been used as a cloak to get money which could not otherwise have been obtained, we probably do not always have sufficient funds for research and development purposes. Congress has usually considered research and development funds as untouchable. You can cut civilian manpower and you can reduce maintenance and operation, but you dare not be against progress, you dare not be opposed to research and development.

It is by reason of the fact that one can almost get by with murder, so to speak, in securing funds for research and development that I raised this question of practicality. I feel that the sky should certainly be the limit, that we should be certain to provide adequate financing for high priority projects such as a truly practical and workable anti-ICBM.

I have before me from Missiles and Rockets Magazine of March 7, 1960, an editorial entitled "Let's Be Daring But Not Ridiculous." I quote the following:

> There is little question that many dollars have been spent on farfetched ideas that have no basis in practicality or even in possibility. By the same token, contractor management has often sold gold-plated R. & D. projects to the military knowing them to be without merit and certainly unworthy of their own company-supported financing. To many the Government appears as a benevolent grandfather bestowing largess on a favored few.

What would be your reaction to that statement, General Trudeau?

General TRUDEAU. Since we are all fallible, I do not think you could say it is a hundred percent untrue. I think when you consider the scrutiny that these proposed projects undergo at several echelons, by and large the statement is not generally true. As far as we are concerned in the Army, we have scrutinized and continue to scrutinize projects because it is true that enthusiasts either in or out of uniform and in industry will frequently try to keep a project going after it has been bypassed by advances in the state of the art or by some comparable development that has a greater potential.

In the Army during the past 18 months we have been able to eliminate somewhere in the neighborhood of 180 projects or subprojects by putting pressure on subordinate echelons to review constantly the things that are being done and eliminate them, by personal inspections on our part and by trying to force our subordinates by telling them that if they want to start something new that looks good, they have to wipe out something that was least profitable in research and development.

While there have been weaknesses, I can see a constant tightening up of procedures that I think reduce such actions to, I hope, a reasonable minimum.

HUMAN RESEARCH

Mr. MAHON. Do you have a series of research and development projects on sociological type questions?

General TRUDEAU. We do.

Mr. MAHON. Tell us a little bit about the humanities. Nobody mentioned that this morning.

General TRUDEAU. This should be mentioned because if there is one thing that is evident in this world today, it is that man—civilization shall we say—in his development has gone so much farther and faster in the physical sciences than in the development of the social sciences that we are in the possible position of destroying ourselves.

Mr. MAHON. Let us get down to cases and explore some of the humanities studies you have.

General TRUDEAU. They go into several fields.

Mr. MAHON. Just what are they?

General TRUDEAU. One of them has to do with the better selection of leadership and training methods that will improve our techniques and save time and money in the training of individuals.

Mr. MAHON. Let us get more specific, if you have the facts.

General TRUDEAU. Specifically, in one of the electronic specialties we have found that we have been able to reduce the training time by over one-third. This saves manpower and certainly saves cost. This is by the study of training techniques. You can consider it a social study if you desire, and that is where it belongs.

Mr. MAHON. How many special studies and projects do you have? List them at this point in the record. Give us the dollars involved and the general situation.

General TRUDEAU. We will be very happy to do that. Do you have a concrete figure to present?

General WOOD. I would rather submit it.

General TRUDEAU. Or General Ely.

General ELY. I have no complete figure. It runs the range of training—training of units, training of personnel, selection of personnel, of human engineering. It totals, I would say, in the neighborhood of $4 million.

Mr. MAHON. Who is doing this work? Give us that for the record and give us at the present time anything you can.

General TRUDEAU. We will submit it for the record.

Mr. MAHON. Give us some information now.

(The information requested follows:)

SPECIAL STUDIES

The Army has three major human factors research areas: training research to include motivation, morale and leadership studies; personnel research to include selection, classification and assignment techniques; and research in human factors engineering and psychophysiology which includes studies of man-machine compatibility and human sensory and perceptual capacities.

Training research is conducted for the Army by contract with the George Washington University, specifically an agency called the Human Resources Research Office of that University, budgeted annually at approximately $2,500,000. It is presently engaged in 39 research studies on tasks described below:

Training Methods Division, Washington, D.C.

FORECAST (10-30)—Development of a Method of Forecasting Training Demands Imposed by New Weapons Systems

REPAIR (10-14)—Training of Electronics Maintenance Personnel

JOBSTRAIN (10-32)—Development of an Integrated School and On-the-Job Training System for Electronics Repairman Personnel

CHECKOUT (10-40)—An Evaluation of a New Method of Electronic Systems Analysis for Maintenance Training

NICORD (10-27)—Training of Ordnance Guided Missile Maintenance Personnel

TRACE (10-35)—Development of Improved Electronic Trouble Shooting Procedures and Teaching Methods

RAMP (10-34)—A Study of the Training and Field Activities of Army Aircraft Maintenance Personnel

CONTACT (10-33)—The Feasibility of Training for Faster Acquisition of Perishable Tactical Information From Non-English-Speaking Prisoners of War

COLDSPOT (10-41)—Human Factors in Military Performance in Extreme Cold Weather

METHOD (10-39)—Developing Training Methods Best Suited to Selected Military Training Problems

TRANSFER (10-42)—Development of Techniques to Maximize Transfer of Training in Selected Man—Machine Systems

DATAFLOW (10-43)—Automatic Data Processing System Operation and Maintenance

ADVANCE (10-44)—Development of Methods for Obtaining Advance Indications of the Training Demands Future Army Organizations Will Place on Army Personnel

U.S. Army Armor Human Research Unit, Ft. Knox, Ky.

ARMORNITE (11-27)—Methods for Improving Performance of Armor Personnel in Night Operations

FIREPOWER (11-26)—Methods for Improving Performance in Tank Gunnery

SPANOCON (11-28)—Human Factors Influencing Span of Control within the Armored Battalion
TANKER (11-30)—Improved Methods for Training Tank Commanders
UNIT (11-29)—Evaluation and Improvement of Tank Platoon Training
LIFT (15-01)—Army Aviation Helicopter Pilot Training
STANDARD (15-05)—Uniformity of Standards Among Flight Instruction and Evaluation Personnel

Director's Office, The George Washington University, Washington, D.C.
PIONEER (01-03)—Development of Methods and Concepts for Training and Motivation Research

Personnel research is conducted by the Personnel Research Branch of The Adjutant General's Office. It is budgeted at approximately $1,000,000. Presently it is engaged in 16 tasks listed below.
INDUCTION—Differential Ability Tests for Induction and Enlistment
NEW CLASSIFICATION TECHNIQUES—New Techniques for Enlisted Classification
UTILIZING WOMEN—Utilization of Women in the Army
TECHNICAL ABILITY—Matching Ability Resources of Enlisted Men to Critical Army Technical Jobs
OFFICER PREDICTION—Prediction of Effective Officer Performance
NCO LEADERS—Selection of NCO Leaders
COMBAT SELECTION—Army Classification Tests for Combat Selection
SPECIAL WARFARE—Selection and Utilization of Special Warfare Personnel.
OFFICER PROCUREMENT—Measurement Instruments for Officer Procurement Sources.
COMBAT ALLOCATION—Assignment and Allocation of Personnel to Combat Units.
ERROR-FREE PERFORMANCE—Psychological Factors in Consistent Error-Free Performance.
RETENTION STANDARDS—Refinement of Retention Standards.
HELICOPTER—Selection of Army Helicopter Pilots.
IMAGE INTERPRETATION—Psychlological Factors in Image Interpretation.
ELECTRONICS—Selection and Utilization of Electronics Personnel.
CIVILIAN SUPERVISORS—Development of Improved Civilian Supervisory Selection Techniques.

Human factors engineering involves the application of data on human performance capabilities to the design of man-machine systems, and related equipments and environments, for the accomplishment of specified missions. It is a scientific endeavor to relate the design of such systems, equipments, and environments to the abilities and limitations of the human beings who will be selected and trained to use the equipment, taking into account both operational and maintenance duties and safety considerations. The objective of this endeavor is reached, the system is "optimized" as regards human factors, only where:

1. The operator is treated in the design process as an integral components of the system with statable intellectual, physical, and psychromotor characteristics; and
2. Similarly statable characteristics of maintenance personnel are exploited for maximum system reliability.

Basic research in psychophysiology, the study of man's sensory and perceptual capacities, is the responsibility of the Army Medical Service, is currently funded at about $450,000, and is conducted in part by contract and in part by in-service efforts at the Army Medical Research Laboratories at Fort Knox, Ky. Each of the other Army technical services has a program in this field which will be outlined in the following paragraphs. The list of current Army Medical Service studies in the field is as follows:

Investigation of Sound and Hearing in Relation to Performance.
Investigation of Vision and Perception in Relation to Performance.
Improvements of Control and Coordination in Performance.
Investigation of Motion and Balance in Relation to Performance.
Studies of Complex Behavioral Processes in Performance.
Studies in Somesthetic Functions.

The Ordance Corps has its Human Engineering Laboratories at Aberdeen Proving Ground, Md.; with small (one or two-man) staffs of human factors engineering consultants satellited at various ordinance arsenals and weapons commands. The aggregate in-house level of efforts for this activity is approximately $600,000 per year. The studies currently underway are as follows:

Physiological and Psychological Effects of Muzzle and Breech Blast.
Evaluation of High Intensity Impulse Noise on Hearing in Animals.
Evaluation of 105 mm. and 155 mm. Howitzer With and Without Muzzle Brakes.
Vigilance and Monitoring of Status Panels and Radar Scopes.
Individual Capabilities and Limitations of Men Operating in Tracked Vehicles Over Prolonged Periods of Time.
Power Ratings for Personnel Performing a Cranking Task.
An Evaluation of Spotting Rounds and Spotting Techniques for Use in Fire Direction.
Visual Detection of High-Speed Low-Flying Targets.
Radar Displays—Integration of Target and Battery Information Within a Defined Tactical Air Space.
Radar Display Interpretation to Counter Countermeasures.
Systems Evaluations of Ordnance Weapons.

The Quartermaster Corps conducts human factors engineering studies in support of Quartermaster items at its Quartermaster Research and Engineering Center at Natick, Mass., and at the Food and Container Institute, Chicago. This QM effort is funded at an approximately $120,000 annual level of effort. Assigned tasks in the current work program are as follows:

QMR & EC, Natick:

Critical environmental factors and the QM-equipped soldier.
Effects of loud noise on sensory perception.
Effects of prolonged small group isolation upon sensory and performance processes.
Study of individual differences in pain thresholds and pain tolerance.
Effects of hand cooling and amount of task training on manual performance.
Psychological and performance characteristics under multiple stress conditions.
Development of techniques to identify and study incompatibilities of man-machine combinations.
Operation and maintenance problems associated with use of the rough-terrain fork lift truck.
Assessment of armor requirements for protection of aircraft crewmen.
Investigation of handwear variables and insulation to provide improved manual performance and protection.
Development of systems for evaluating manual performance.
Isolation of basic manual movements and effects of cold exposure on same.
Effects of extreme climatic conditions on hearing thresholds.
Effects of steady-state and impulse-type noise on hearing.
Usefulness of facial protection to reduce environmental effects on visual functions.

Food and Container Institute, Chicago:

Methods for measuring and predicting food acceptance.
Interactions of taste qualities.
Food preferences of men in the Armed Forces.
Variability in taste perceptions of different compounds.
Study of thresholds and quality judgments of odorants in relation to their physico-chemical properties.
Interaction of preference qualities of successively served food samples.
Behavioral indices of acceptance.
In-flight reactions to components of semisolid meals.
Personal and attitudinal factors associated with resistance to irradiated foods.
Food preferences in Arctic environments.
Compatibility of menu items.
Repetitive menu cycles in the feeding of small groups.
The bases for changing food attitudes.
Relations of feeding procedures to social-psychological attributes of small groups.

In the Signal Corps, at the U.S. Army Signal Research and Development Laboratory, a small (three-man) in-service staff monitors contract development of selected aspects of Signal Corps equipments. Current tasks underway, at approximately a $12,600 funding level, in this contract programs are as follows:

Human engineering design of remote control system AN/UPW–1.
Speed and accuracy penalties of multiscales meters.
Pattern recognition errors associated with I. R. display.
Human factors in Detonation Location Central AN/GSS–5.
Environmental conditions in Signal Corps shelters and vans.
Human engineering review of Radio Set AN/GRS–53.
Human engineering review of Telephone TA–312 PT.
Design standards for man-machine tasks in Signal Corps systems.
Human engineering design recommendations for miniaturized equipment.
Development of an index of electronic maintainability.

In the Transportation Corps a human factors engineering effort is only beginning to be initiated and is tentatively funded at about a $200,000 annual level of effort. Present planning is that initial requirements are concerned with accident hazards in small fixed and rotary-wing aircraft and with maintainability of Transportation Corps equipments.

In the Chemical Corps a small inservice laboratory, funded at approximately $90,000, is currently working on the following studies:

Psychopharmacological studies to determine the behavioral effects of certain drugs and chemicals.
Effects of military chemicals on operational performance.
Human engineering review of E 41 Field Alarm.
Human engineering review of Kit, Conversion, Medium G. P. Tent, Protective Shelter, E 21.
Human engineering review of Mask, Gas, Rocket Propellant, E 15.
"Repellant" underwear fabrics.
Use of diffusion materials in underground shelters.
Human engineering review of Field Decontamination Kit.

The Corps of Engineers currently has no human factors engineering program; is considering requirements for the establishment of such a program.

General ELY. Our major effort, I would say, in the training area is a contract with George Washington University. We have a contract there for something in the neighborhood of $2.5 million a year whereby studies are made of training methods. The contractor units at Fort Bliss, at Fort Ord, at Fort Knox, at Fort Rucker, at Fort Benning, work right with the training units themselves, the training commanders, the schools, and scientifically analyze better approaches to maintenance, better approaches to the utilization of the equipment, better approaches to training in firing the weapons, and matters of that nature.

Mr. MAHON. Do you think of other types of studies that are being made in the field of research and development in the humanities?

General ELY. We have human engineering studies; not much money goes into this. The purpose there is to study the relationship between the individual and the equipment he has to use.

Mr. FLOOD. Off the record.

(Discussion off the record.)

Mr. MAHON. You heard Mr. Flood's observation. What would you say?

General ELY. I agree with his observation. If you really tie it down to the accepted definition of the teaching of the humanities, I do not believe we have much in our program in the way of research of that nature.

If you tie it to the use of the man and the use of equipment, as we are doing, then we have that.

Mr. MAHON. Everything you have said to date is very inconclusive and unsatisfactory from my standpoint. Do you have a list of these projects? You are asking money for research and development. If you do not have a list and cannot explain it——

General TRUDEAU. We have a list.

Mr. MAHON. What is it?

General TRUDEAU. It will be presented, sir.

General ELY. I have a detailed list of all the studies being done in this category I have just been discussing.

Mr. MAHON. Do you have a list of the funds requested for these studies?

General ELY. Yes, sir.

Mr. MAHON. Why do you not discuss some of those?

General ELY. I was discussing the largest item, which is $1,800,000; last year it was $2.5 million. The contract is with George Washington University for the study of training methods, morale, motivation, leadership, and so forth. That is the larger item.

Mr. MAHON. Do you have a list you could give us to look at?

General ELY. I have a breakdown of all the projects they do under that specific study.

Mr. MAHON. Do you have an extra copy?

General ELY. I can give it to you or furnish it for the record.

Mr. SIKES. Mr. Chairman.

Mr. MAHON. Mr. Sikes.

RESEARCH ON BRAINWASHING

Mr. SIKES. In connection with the study you have just listed, as a part of that study or another study is there any specific work being done in R. & D. toward developing the best means by which to offset the problems which we had in Korea when so many of our personnel yielded to Communist brainwashing?

General ELY. In the Medical Corps we have research on the effects of stress and loss of sleep and loss of food and other things on the soldier.

Mr. SIKES. That does not answer the question and is not responsive. It seems to me there is a very important field. If you are going to do research on human attributes and human activities, it would appear this subject of susceptibility to brainwashing should be included. Apparently that is not true.

Mr. MAHON. He has not said so.

General ELY. Offhand, I know of no study that goes any deeper into that.

General TRUDEAU. I do not believe we are deeply involved in that subject at all. I could not identify a specific project on that.

Mr. SIKES. You know how serious that matter is. Do you not think that is something we should seek more information on?

General TRUDEAU. The Bureau of Education should. This goes back to the basic training of our youngsters in the school, or lack of it.

Mr. SIKES. You take people as you get them.

General TRUDEAU. We do.

Mr. SIKES. Do you not think from the standpoint of best use of those people, that you should be working on a program to help steel men against future brainwashing?

General TRUDEAU. That is done in connection with the citizenship training and other training in connection with the code of conduct in which they have extensive training in every basic training center. Perhaps it is not extensive enough.

Mr. SIKES. I am afraid it is not extensive enough. I wish it were more so.

General TRUDEAU. It could be. I will investigate it more closely and provide something for the record.

(The information requested follows:)

Since the Korean war, followup studies on POW's to evaluate brainwashing have been supported at Walter Reed and the Massachusetts Institute of Technology. This work is now completed and books should be published this year by Drs. Lifton and Shein. Basic research on hypnosis and intrapersonal influence is continuing at Walter Reed. Funds required are $20,000 per year.

Mr. FORD. If the gentleman will yield, on the point raised by Mr. Sikes. Several years ago the Army panel held extensive presentations on the results of a series of studies made with prisoners of war, as I recall, from the Korean emergency. This was given to us by a Ph. D. and an officer.

Mr. SIKES. A young major, who did an extraordinarily good job before our committee.

Mr. FORD. Has that information, which seemed invaluable, been utilized in any R. & D. program or project?

General TRUDEAU. It is utilized in training programs but I would not say it was in R. & D.

Mr. MAHON. Read us off some more of those, please, General.

HUMAN RESEARCH STUDIES

General ELY. Studies we are doing under this George Washington contract: at Fort Benning we have a study called Rifleman, which is designed to improve the combat proficiency of the light weapons infantryman.

We have a study called Swing Shift for developing techniques of training methods for improving individual and squad infantry performance in operations during limited visibility.

At Fort Knox we have a study called Armornite, seeking methods for improving performance of armored personnel in night operations.

We have one called Firepower, seeking methods for improving performance in tank gunnery. We have three or four more at the Aviation School at Fort Rucker.

SLEEP RESEARCH

Mr. MAHON. Do you have any studies that deal not with training people in using rifles but with more purely psychological issues and questions such as the study on sleep which came under fire a few years ago, and which was, as I understand it, modified. What happened to that?

General ELY. We still have a small study done by the medical service on stress.

Mr. MAHON. What did you do with the study on sleep?

General ELY. I was not here, but I believe there was a lot of misunderstanding about what we were really studying, which was the effect of deprivation of sleep, which is a stress factor.

Mr. MAHON. I do not remember the details of it, but I know there were some things in connection with some of these studies that did not go over very well with the country and with the Congress. I think they were modified to advantage, but I do not know the details at this time.

General ELY. There is no study on sleep at this time.

Mr. MAHON. I would not say there is not an appropriate reason to study stress and sleep. I think it would be very important under certain circumstances. Give us a list for the record of these projects and the costs.

STUDY ON STRESS

General TRUDEAU. This study on the matter of stress is of major importance. It goes into how much a man can take listening to a radio continuously; what should be the level of decibels, for instance? You read of keeping men in a buttoned-up tank for a long period of time. It will be probable under conditions of radioactive fallout that they may have to stay locked up in a tank for a long time.

Another important field I must mention here is what we call man-machine compatibility. In other words, the cross section of our manpower is about the same as far as intelligence is concerned—maybe it is upgraded a point or two in its IQ—but, by and large, it is the same cross section of people, and yet we have a tremendous number of very complex weapons that they have got to operate and maintain.

Consequently, the means of operating these weapons and particularly of maintaining them have got to be simplified to the utmost degree, preferably a red light-green light signal that says it works or it does not work and, if it does not work, you take out a part and put in another one. This is a very extensive program and begins from the time we start to study a new program at the very earliest time.

(The information to be supplied follows:)

STRESS

The Army conducts several research tasks directed specifically toward the stress problem. Of course, all training research is directed generally toward improved performance under stressful situations.

Total cost of stress research is approximately $502,000.

Tasks follows:

By Human Resources Research Office:

Task Endorse: Effects of controlled isolation on performance. Cost, $112,000.

Task Fighter: Factors related to effectiveness and ineffectiveness of individuals in combat. Cost, $140,000.

Task Coldspot: Human factors in military performance in extreme cold weather. Cost, $45,000.

By Personnel Research Branch, the Adjustant General's Office:

Army classification tests for combat selection, $75,000.

Men in fighting vehicles. Cost, $30,000.

The Ordnance Human Engineering Laboratory task: Individual capabilities and limitations of men operating in tracked vehicles for prolonged periods of time. Cost, $50,000.

Walter Reed Army Institute of Research: Basic research on the mechanisms of diminished purposeful mental and physical activities following sleep deprivations. Cost, $50,000.

RESEARCH AND DEVELOPMENTAL LEVEL

Mr. MAHON. I would like to ask you this, General. Proper research and development is of the greatest importance and significance. In your judgment and in the judgment of people who work with you, is the level of research and development approximately right or is it vastly too big or vastly too little? I would like to get some idea about this particular issue.

General TRUDEAU. I must say that I think we are operating in the Army R. & D. on what I would call a reasonably austere budget. This is the way I put it. There are many other things we could do. There are some things we were doing that undoubtedly will have to be cut off as low priority projects, and we watch for those every day, but generally speaking we are operating at a fair level, I believe.

Mr. MAHON. You would not, if you had the power, double R. & D. for the services or anything of that kind?

General TRUDEAU. No, I would not.

COMPANIES RECEIVING R. & D. BUSINESS

Mr. MAHON. Changing the questioning a little, you made reference in the film involving NIKE-ZEUS to various companies who work on components of the NIKE-ZEUS. While the film was going on and references were made to this company and that company and to this town and that town and some other State and area, someone said that there is something in this project for everybody.

I would like to explore a little this business of the big companies with which you do business. List the 10 companies who have the biggest share of the business with the Army in Army R. & D.

General WOOD. May we submit that, sir?

Mr. MAHON. Yes.

General WOOD. I could certainly tick off four or five. After that I would not be sure.

Mr. MAHON. Give us four or five.

General WOOD. Certainly the two principal contractors of ZEUS moneywise, who have a big share of the business, are Western Electric and Bell Laboratories, which are essentially together, and Douglas Aircraft. Next is the Martin Co., working on PERSHING. Next is probably Raytheon, working on the HAWK.

(The list of 10 companies referred to follows:)

Ten prime contractors having the largest share in the Army R. & D. field, fiscal year 1959

	Million
1. Western Electric Co.	$173.6
2. Martin Co	79.3
3. Sperry-Rand Corp	37.5
4. Raytheon Manufacturing Co	31.9
5. Republic Aviation Corp	26.8
6. Radio Corp. of America	19.2
7. Fairchild Engine and Airplane Corp	14.3
8. Sylvania Electric Products	14.1
9. General Electric Co	10.7
10. Minneapolis-Honeywell Regulator Corp	10.3

Mr. MAHON. Generally, these research and development type contracts carry on over into actual production contracts for Western Electric and Chrysler and these other companies; is that not correct?

General TRUDEAU. Yes.

General WOOD. Generally, they do. It is not certain they will because a production contract is usually put out on competitive bid. It is certainly correct to say that the company which has been doing the R. & D. is in a good position to get a production contract if it has the capability.

General TRUDEAU. I would like to enter for the record the statement of Raytheon that in this HAWK contract, Raytheon had 3,500 subcontractors. This must reach down into quite small business.

SOVIET TROOP REDUCTIONS

Mr. MAHON. You know of the announced intention of the Soviet Union to reduce its troop strength. Do you think one reason for this reduction is that the Soviet Union is beginning to place more emphasis on missile firepower and less on manpower, as the United States has been doing in recent years?

General TRUDEAU. Not necessarily. I think they are placing tremendous impetus or effort behind their missile business, but the Soviets are badly pressed for manpower. Their agriculture is relatively inefficient, and they need to expand their industrial base. They have to recapture the manpower from some source to do one or both of those two things.

Furthermore, they must recognize that against any threat from the free world they do have excessive manpower under arms.

LAG IN DEVELOPMENT OF WEAPONS FOR GROUND TROOPS

Mr. MAHON. In our report last year this subcommittee referred to the apparent lag in development of weapons for ground troops in the Army. There was some feeling that the Army had been so engrossed in long-range ballistic missiles that less ambitious and less spectacular programs had unnecessarily lagged.

You enumerated several ways in which development time is lost. Can you give us some concrete examples showing how these factors have slowed specific development programs?

General TRUDEAU. Of course, under the system of free enterprise in the governmental system we have in the free world, both our industry and our military developments are relatively slow. In industry they progress no faster than the market will justify and their competitors force them to do.

By and large, leadtime in this country between wanting and getting, we will say, is 8 to 10 years. The Soviets are much faster because of the system under which they operate.

We certainly do not want to adopt their system, but we do want to reduce that leadtime. As mentioned, in JUPITER we went down to about 3 years, and in the DAVY CROCKETT we will be down to about the same. In this GOER program, where we have insisted on staying with commercial practice and commercial components, a hundred percent right now—we may have to put in some special things —this is down to less than 2 years, which is truly remarkable.

Mr. MAHON. You made some rather sweeping statements about this lag, and I would like to have some specific examples for the record.

M–14 RIFLE DEVELOPMENT TIME

General TRUDEAU. One good example is the M–14 rifle. In addition to the development itself, we had the competition between the M–14 rifle and the Fabrique Nationale (the Belgian rifle) and we also got into common standardization with our NATO allies of the individual round. It was well over 11 and as much as 14 years from the time the first prototype of that rifle came up to the time it was put into production.

LAG IN LACROSSE MISSILE

Mr. MAHON. Now another example or so. What about the horrible and unspeakable experience with LACROSSE?

General TRUDEAU. Those are your words, Mr. Chairman, not mine. We do not think it is that bad.

Mr. FLOOD. May I add mine?

General TRUDEAU. Very good, sir.

Mr. FLOOD. I adopt my friend's language.

General TRUDEAU. In all of these research and development projects you are entering a brandnew field. In both LACROSSE and HONEST JOHN we had nothing to go on. We were starting from scratch with new scientific breakthrough. Naturally, the time involved in some of them and perhaps the cost in some of them was greater than we would have liked to have had.

Now we are moving into a second generation, based on extensive knowledge of missiles and space acquired over the past 10 years. From here on out we should be able to expect a more efficient job through the research and development cycle.

Mr. MAHON. How long has this LACROSSE thing been going?

General WOOD. Since 1951, 9 years.

Mr. MAHON. Nine years and we still do not have LACROSSE.

General TRUDEAU. Yes; we do.

Mr. MINSHALL. Something like BOMARC, Mr. Chairman.

General WOOD. Four units were activated at Sill prior to the first of the year; two more since the first of the year. The first ones will be deployed overseas this summer.

Mr. MAHON. How much was spent or obligated to date? You may put that in the record at this point.

General WOOD. R. & D.

Mr. MAHON. The whole field of LACROSSE.

General WOOD. I have only the R. & D. here, $73 million since the beginning.

Mr. MAHON. Since 1951?

General WOOD. Yes, sir.

(The information was supplied to the Committee.)

Mr. FLOOD. If the gentleman will yield, you have a weapon which, to my knowledge, has been going on for 10 years actually—this is the 10th year. You are aware and we are aware—and we have developed this extensively with the Marines—when it was first born and showed signs of possibilities, the Marines came to you and said, "Help us take a look at that," which you did.

Then over a period of years this thing slipped and slipped and slipped, and if ever your slip was showing in Army R. & D. and Ordnance, it showed on this pigeon.

Now, the Marines finally said to you, "We don't want this." They gave you a list of reasons why not. With all respect to the Army—and nobody has a higher regard for the Army than I have, and you know it, I am your best friend and, therefore, I have the right to be your severest critic, like your wife—we had the Marines in and we spent a lot of time with the Marines on LACROSSE 2 weeks ago.

The Army is a great field combat outfit. The Army is the first outfit to say, "So are the Marines."

General TRUDEAU. Right.

Mr. FLOOD. Let us say you are even for my premise. It is the considered opinion of the Marines, and they are just as good as you are in the field—now, listen to this, this has nothing to do with the fact that this costs ——— a round without the warhead, this has nothing to do with the fact that the Marines say it is not as reliable as you say it is, we are going to balance this thing out and say, "All right, let us bring these together," and we are even with all these disputes—

(Discussion off the record.)

Mr. FLOOD. All these things being evaluated in this equation, the Marine Corps, who want this like they want tomorrow, who need this weapon ever since the halls of Montezuma, this kind of thing is what they want, they are crying for it, they want it so bad they can taste it, and they tell us this weapon is of no use to them.

General TRUDEAU. If that is their view, they are apparently misinformed in this area.

Mr. FLOOD. That is why we are here. You say they do not know what they are talking about.

General TRUDEAU. They are apparently misinformed.

Mr. FLOOD. Here are two equally responsible and reliable combat elements of the Department of Defense. So after 10 years of a highly questionable performance, we are aware of both sides of this equation and all of its elements, and in spite of this the Army is sending this month to our troops in the field in West Germany two operational battalions of a weapon that the Marines say they don't want. Do you have any doubt why we have reason to give this pause?

General WOOD. May I say a few words, sir?

Mr. MAHON. Yes.

General WOOD. I recall having sat behind the Chief of Staff here, when this question came up and General Lemnitzer, I thought, made fairly clear the difference in the Marines and Army contemplated use of this weapon. This explains in part at least the Marine views.

In the first place, let me say this weapon was conceived in 1951 and it was conceived initially because it was desired to have a very accurate guided missile which would have a guidance system which could be passed from the launcher area to a forward observer and would enable that forward observer to direct that missile with a large high explosive or atomic warhead accurately into some of those caves and strong points that the North Koreans and Chinese were using in the Korean war. That was, I think, quite accurately the inspiration for a missile of this type.

In 1951, we did not know a lot of things that we know today. We really pushed the state of the art considerably to come up with a mis-

sile system which would do this job. We reckoned during that time that we probably could not get quite the accuracy desired.

(Discussion off the record.)

General Wood. However, this was all we had to work with at that time. The state of the art allowed only that. We hoped we could produce a better system before we got through.

The Marines since the Korean war have wanted a weapon which would give heavy firepower, particularly in landing operations, because that is the Marines particular forte. You have noticed in all their work the desire to have as much firepower as possible in a restricted beachhead or other such locality.

The LACROSSE system as developed does not satisfy them. So far as the accuracy is concerned, we have achieved that, and I think the Marines would not say that we have not. The design accuracy of this system was from ——— circular probable error depending on range, which is amazing compared to most missile systems.

Before the Chief of Staff directed the procurement of this system and its installation by field troops, he decided on a limited number of battalions.

The Chief of Staff decided that this system was valuable because it was accurate.

To go into a new development would require 5 years and $200 million, and we would have Missile A before that time, which would do the job we wanted. That is the Army's story on it. I quite agree that we do not agree with the Marines because our planned use is different.

Mr. Mahon. In using the uncomplimentary word which I used in reference to LACROSSE, I did so somewhat with a twinkle in my eye, but I have heard many derogatory things and I am of the opinion that this system has not been developed very well. I think if it were as good as it ought to be, the Marines would want it. That is my general feeling.

AVRO CAR

Mr. Ford. Mr. Chairman, on this point of leadtime may I ask a question about an item that General Trudeau or that General Wood mentioned?

Mr. Mahon. Yes.

Mr. Ford. Take this AVRO principle. This is a new principle, more or less. I am not sure in my own mind just how the hardware that will result from it will be used. How long will it take you in this item to get hardware which will be militarily desirable?

General Trudeau. This is hard to tell. This is proving out a new aerodynamic principle. We are hoping that this will fly successfully in its test flights at any time now. I do not mean just hovering above the ground. We do not know.

Mr. Ford. It is just a principle and not related to any specific piece of hardware as of now?

General Trudeau. The vehicle could be most useful in its present state or in other advanced or enlarged states if the principle proves out.

General Wood. It is a principle at the moment. If it is successful, it could replace helicopters. It could be a weapon platform as well

as troop transporter or cargo vehicle. It has the capability to go up and down and, in theory at least, it can fly faster at higher altitudes than a helicopter. However, that is theory and we have to test out the two prototypes we have manufactured.

General TRUDEAU. Off the record.

FACTORS AFFECTING LEADTIME

Mr. MAHON. General Trudeau, on page 3 of your statement you more or less came out of your corner slugging, so to speak, with this paragraph:

> As I mentioned last year, the early availability of new weapons and equipment is not only dependent upon availability of funds, it is also influenced by leadtime. Money can buy many things, but it can't buy time—time lost through lengthy administrative procedures, deferred decisions, lack of vision, timidity, complacency, misdirected or fruitless effort, or through inadequate funding.

To whom is this directed? Give us some specifics about timidity, complacency, misdirection. You mentioned one weapon. Let us get some more specifics here.

General TRUDEAU. These delays occur up and down the line. Funding, needless to say, is not only a matter of the appropriation by Congress after your committee has made its recommendations, with such modifications as they desire to make, of course, but also on the release of these funds by the Bureau of the Budget and then by the release of the funds by the Department of Defense, assuming that the Director of Research and Engineering approves the release of those funds.

Mr. MAHON. What I am interested in is projects in which these kinds of things have played a part, and no doubt there are those. I would like to spread some of them on the record here.

General WOOD. Let me give you some specific items from action by, shall we say, higher authority on funds included in the congressional fiscal year 1960 appropriation. This would speak directly to the point you have in mind of time lost due to administrative process.

Mr. MAHON. You are talking about for modernization of the Army?

General WOOD. No, sir, I am not speaking of that point. I am talking about delays either in the Office of the Secretary of Defense or the Bureau of the Budget to either give program approval to what had already been approved when it went into the budget, or release of funds through what is called the apportionment process.

Mr. MAHON. That is a good policy answer.

General WOOD. MAULER I described this morning. We wanted to get busy on that as soon as possible. The Office of the Secretary of Defense placed this on the deferred list on August 31, last year, and finally on December 15 gave us authority to go ahead. That time may not be great there, but it does indicate a time since passage of the legislation before we could get started.

I could mention another one, the PERSHING. The Bureau of the Budget decided that there was in the PERSHING program some $2.5 million which was questioned whether or not it represented duplication of profit by principal and subcontractors. Eventually it was shown that it did not, and on December 15, they released that money.

You might say in both those cases higher authority had justification for wanting the Army to prove its case, but nevertheless there were administrative delays.

Mr. MAHON. If you think of anything more to add in response to my question, I wish you would do so.

(The information requested is classified and is being supplied the committee separately.)

Mr. MAHON. Mr. Sikes.

DELAY IN M–14 RIFLE DEVELOPMENT

Mr. SIKES. We were talking a moment ago about the delays in adoption of the M–14 rifle. Ours is the last major Army in the world to have a new rifle which was developed since World War II. How could it possibly have taken so long to decide what we wanted in the way of a new rifle? We are just now beginning to get new rifles into the hands of troops. Do you know why it has taken so long?

General TRUDEAU. I cannot give an answer.

Mr. SIKES. It seems to be an illustration of the sort of thing you are talking about.

General TRUDEAU. A part of it was the NATO negotiations.

Mr. SIKES. NATO nations took the Fabrique Nationale a long time ago.

General TRUDEAU. Industrial problems and competition in this country had something to do with it.

General WOOD. NATO standardized on the round of ammunition only and said that the NATO countries could produce their own rifles.

Mr. SIKES. Most NATO countries took the Fabrique Nationale rifle after NATO had standardized on the round, but we could not decide what we wanted and we dillydallied for years.

Mr. FORD. May I ask a question there? The delay in the M–14 did not relate during this long period of time to any inadequacy of funds, but it was, rather, administrative indecision instead of funding; is that right?

General TRUDEAU. As far as I know, that is right.

M–60 TANK PROGRAM

Mr. SIKES. That is right. Let us take the tank. Our M–48 tank is no match for the new Russian tanks with which the Russian troops are equipped. Not only that, but the Russians have a great many more tanks than we have. We have taken a long time to come up with a first-class tank. We now have a first-class tank, the M–60, which we are beginning to buy. Yet we had to borrow a gun from the British in order to have an effective weapon on it.

Why did it take so long for us to come up with a first-class tank and why could we not develop a first-class gun for it?

General WOOD. Let me address myself to the gun. As part of the mutual weapons development project, for which the Congress appropriates money annually, the United States—and this includes all three services—is able to put a certain amount of money into foreign developments, not ever more than 50 percent of what the other country

is putting in, in order to do things that we are not doing or in order to complement what we are doing.

We worked on the 90-mm. and the 120-mm. and the British worked on the 105-mm. gun system. Subsequently we had comparative tests, both the British and ourselves, and we determined that of the three the 105 was the best for the tank.

You might say: "Why was not our 90 better or why was not the 120 better?" It gets into a technical discussion that would be difficult to answer. But based on weight, range, accuracy, et cetera, the 105 was the best for the job. We are going to manufacture it, as you know, Mr. Sikes.

Mr. SIKES. But it has taken a long time to get to it. The Russians already have very good tanks in the hands of troops. It was developed since World War II. It has a first-class gun. We are just starting to procure ours.

Mr. FLOOD. I might add this, in fairness to the ordnance people. They have taken that British 105 and have modified it and improved it to such an extent that the new American gun, the British gun with the American modifications, has now been adopted by the British on the tank they were trying to sell the Germans. The new rifle is an improved British gun and the improvements are American.

ANTITANK MISSILE DEVELOPMENT

However, there is something else. You certainly did not put very much money into the West German development of the guided antitank missile, which the Marines have now taken and which you have to take, too. You spent all kinds of money and all kinds of time and you spent a lot of hours up here telling us what a great job you were going to do on a guided antitank missile. While you were doing that up here, telling us about this, we were testing the French missile down at Aberdeen.

General TRUDEAU. We test every missile.

Mr. FLOOD. You went beyond that and finally bought the West German article, which is strictly their pigeon.

General TRUDEAU. We have not bought the West German item.

Mr. FLOOD. But you are going to buy it.

General TRUDEAU. I am not sure.

Mr. FLOOD. Have the Chinese come up with one better than the Germans?

General TRUDEAU. There are many different approaches to the problem, and you have to go to a certain point before you know what is best.

Mr. FLOOD. Why is ours always second and third best?

General TRUDEAU. It is not. Of all the weapon systems in the world, there are only two or three we are trying to buy from others. However, we do not have a monopoly on the world's brains.

Mr. FLOOD. That is very obvious.

POSSIBLE CHANGES IN ADMINISTRATIVE PROCEDURE

Mr. MAHON. Now that we have reached a point of unanimity, let us proceed. In view of this deplorable situation we have discussed here for several minutes, what changes do you advocate in adminis-

trative and funding procedures to make them less complicated and more flexible?

General TRUDEAU. Specifically:

A uniform method for expediting selected high priority development projects;

Closer coordination between interested agencies on all projects;

Specific check points of coordination during the development of major projects to assure mutual agreement at critical action or decision points as to whether to continue, reorient, or cancel the project;

An expanded qualitative material requirement (QMR) to include all information known to the preparing agency, with provision for the Chief of Research and Development, where appropriate to declare the qualitative military requirement adequate to serve as military characteristics and thus save the time required for separate preparation, staffing, and approval;

Inclusion in the approved military characteristics or QMR, where adequate to serve the purpose of military characteristics, an acceptable end item unit production cost as a development objective, and this is a real forward step.

In addition, we are trying to insure that sufficient numbers of the prototype are purchased when we reach that point, and if the unit cost is cheap enough so that we can carry on engineering tests and the user tests at the same time, rather than one following the other with the year's lag.

Of course, another thing that is extremely important, but one of the difficult things to do under the congressional desire for the selection of the low bidder on a contract, is to try and get the production tooling carried on along with prototype development, certainly by the time it reaches testing and evaluation, but you cannot do this unless initial production can go to the developer. This presents problems, as you know.

Mr. MAHON. Do you advocate overlapping and telescoping of some phases of the R. & D. cycle on a few important programs?

General TRUDEAU. I certainly do, and at every place where it is reasonable.

Mr. MAHON. Unless you were quite sure an item would be procured in operational quantities, you might possibly, of course, waste large sums of money by starting production tooling at an early point in development; might you not?

General TRUDEAU. This is again a question of judgment. It is always a question of the degree of success that is being achieved with the testing and production of the prototype where that decision has to be made, and that decision, of course, is done by the Assistant Secretary of the Army for Logistics or my opposite number, who is the Deputy Chief of Staff for Logistics.

ARMY-INDUSTRY TEAMWORK

Mr. MAHON. To what specific areas were you referring on page 4 when you made reference to intensified Army-industry teamwork and new procedures for expediting development?

General TRUDEAU. I think the explanation of what we are trying to do with our aircraft program and where we brought the industry in to help us to develop basic designs and basic concepts is indicative of

our efforts. In addition, we have a briefing team that spends a great deal of time going to different points of the country where we bring in all interested parties and industry—those who are cleared for classified information—and give them a complete briefing on everything that we are trying to do. They, in turn, give us a briefing on what they claim to be their capabilities.

This is resulting in much closer collaboration between my office and the major industries of the country which, again, is helping to cut down the time between when we have an idea and when we can start doing something about it.

Mr. FLOOD. If the chairman will yield, we have just had an experience with the Air Force on this problem. I do not know if you know about it, but if you do not know about it, let me tell you about it.

A couple of weeks ago the Air Force came in here and they made the same kind of overtures to four or five companies about building a specific type of transport aircraft. Then they came to us with what, in effect, is a supplemental appropriation request about which nobody knew anything and frankly admit—or I understand they admit—that the reason they wanted to build this thing and the reason they want to pay so much money for it is because they kind of half promised this company, or these companies—and there were several tried—something if they came up with this thing. Now the Air Force feels obligated to adopt a lot of aircraft company costs and problems we must pay for.

If you go any further with this operation, with your aircraft, never come in here like the Air Force did a couple of weeks ago, and tell us that because you invited, or intrigued, or seduced, these poor aircraft companies into making offers to you, that now we must pay for all of these gingerbread problems.

General TRUDEAU. We have made the understanding very specific that this incurs no obligation or any indication of a positive intention by us to deal with any particular firm.

Mr. FLOOD. I wanted the record to show this out of an abundance of caution and that you do not come in like the Air Force did a couple of weeks ago with tears about these poor aircraft companies.

General TRUDEAU. We accept that, Mr. Flood.

ACHIEVEMENT OF 4-YEAR DEVELOPMENT CYCLE

Mr. MAHON. Are there any other problems connected with the achievement of a 4-year development cycle you have not presented to us?

If you do not have that, you can supply that for the record.

(The information follows:)

The 4-year cycle is a desirable goal and admittedly a very ambitious one. It has become a goal primarily because of the necessity to develop our weapons and equipment in less time than the U.S.S.R.

At the same time there are forces peculiar to the R. & D. area which make it difficult, and sometimes impossible for us to achieve a 4-year cycle. These include:

(*a*) *State of the art.*—In cases where stated requirements are bold and push the state of the art to the degree that extended research must be accomplished, the current and projected rate of technological progress is such that initial proposed lines of development may become outdated before they are completed and time from concept of production roll off may seem unduly long. This is il-

lustrated by the AN/VRC–12 tactical radio project. The MC's as stated in 1949 were far in advance of the technology of the time and major research was required to solve the many problems. In 1955 just when vacuum tube versions were made available to the Signal Corps R. & D. Laboratory, the feasibility of transistorization had been established and to continue development of the vacuum tube version would have resulted in the issue of out-of-date equipment. Thus, the project was reoriented toward a transistorized version and this model finally type classified in September 1959.

(*b*) *Frequent user change.*—Frequent user change presents a dilemma. We would like the user to look clairvoyantly into the future, be definitive in his requirements, and remain steadfast with that requirement. At the same time we must recognize that the state of the art of warfare, especially in this scientific age, must also progress. Too, technological breakthroughs in the development of companion weapons and/or equipments affect the intended employment of the item under development. Major changes in user requirements during the development phase almost invariably increase the development cycle. However, we must recognize the merit of some of these changes. For not to do so may give us an inferior weapon or one the user does not want.

(*c*) *Procurement cost.*—I need not remind you of the tremendous cost involved in outfitting the Army with a new piece of equipment. At times this cost may prohibit us from working on a 4-year cycle. Thus in some cases the development cycle must be managed to a time frame which will allow us to purchase the item. A case in point again is the AN/VRC–12 radio. The development on this piece of equipment is complete and it will replace the AN/GRC–3 through 8 series radios. To effect this replacement in its entirety will cost in the neighborhood of $225 million. To take advantage of the state of the art in micro-module techniques and miniaturization we are now starting development of a new radio. Were this new radio to be developed in 4 years, how long would it sit on the shelf before we could afford to buy it? And then how outdated would it be and how many more developments would have come along and passed this shelf item by?

(*d*) *Multiple development.*—Very seldom is a concept so clearly defined that the path to success is definitively laid out before us. At the time of inception of a project more than one solution appears plausible and frequently because of the state of the art the most optimum solution is not determinable. Where funding is available, concurrent multiple development along parallel lines is quite frequently undertaken with the less desirable development dropped as soon as it becomes apparent. This reduces leadtime. Conversely, to have had to try out these two or more avenues in series may have added years to the development. For example, we developed two versions of the M113 armored personnel carrier—aluminum and steel. Following evaluation and preliminary testing we proceeded with the aluminum version of the carrier.

EXAMPLES OF DEVELOPMENT LEADTIME

Mr. MAHON. Will you illustrate the leadtime problem by using as an example some weapons operational recently and tell us when these development programs were initiated?

You already referred to some and when you get the transcript, make reference to others if they seem appropriate.

General TRUDEAU. Yes, sir.

(The information follows:)

In considering recently 100 representative R. & D. items which use the product of all seven of the Army's technical services, the average time from concept to availability was found at this time to be 6 years, 11 months. I am sure you realize the pitfalls of averaging leadtimes for unlike items, such as the JUPITER missile and a combat crewman's helmet. In some cases a leadtime of 8 to 10 years is acceptable; in others—high priority items—it is prohibitive. There follows a listing of operational weapons with an indication of the lead-

time involved. Elsewhere in the record I have illustrated the leadtime problem with a discussion of specific examples.

Weapon	Development initiated	Development completed	Leadtime
CORPORAL	January 1950	March 1952	2 years, 2 months.
JUPITER	November 1955	December 1958	3 years, 1 month.
Flamethrower, mechanized, M7A1-6	July 1955	March 1959	3 years, 8 months.
HONEST JOHN	May 1950	February 1954	3 years, 9 months.
Rifle, 106 mm., M-40	March 1950	November 1954	4 years, 8 months.
NIKE-HERCULES	March 1953	June 1958	5 years, 3 months.
Flamethrower, portable, M2A1-7	do	December 1958	5 years, 9 months.
Gun, SP, 90 mm., M-56	July 1950	April 1958	7 years, 9 months.
LACROSSE	do	July 1959	10 years.
Rifle, 7.62 mm. M-14	July 1948	do	11 years.

OVER-REFINEMENT OF MATERIEL

Mr. MAHON. You put your finger on two of the most repeated criticisms of the military research and development programs when you said that you will freeze a good design early without trying to attain the optimum design, and when you say you will seek reliability with simplicity.

Do you feel our research and development programs have been plagued with overcomplexity and too much refinement of a good design in an effort to obtain only a relatively small improvement?

General TRUDEAU. Yes, I do.

This is always a problem with the enthusiasts in or out of uniform, and with industry. They will come up with a design and then, since we are perfectionists by nature in this country, they will continue to try to convince us that if you give them another 6 months or a year, and some more money, of course, that they can come up with a much better job.

What we have got to do is to cut something off where it is 92 percent reliable, let us say, instead of going beyond the point of diminishing returns and seeking 94 percent perfection at a cost of another year in time and, perhaps, great additional funds. This is a definite objective, very positive.

Mr. FORD. Could I ask a question?

Mr. MAHON. Yes.

M-60 TANK PRODUCTION

Mr. FORD. Right on that point, General Trudeau, concerning the decision on the M-60 tank. There is a competition now going on for what, 720, 780 of such tanks?

General TRUDEAU. I believe that is about right. It is a procurement matter.

Mr. FORD. There has been some delay already. The net result of that was to authorize a continuation of the present production line for 3 months, so there would not be a break or lag in delivery. Now it develops that because of some indecision about the handling of the invitations to bid, and the award, that there is likely to be another 3 months' break unless we extend the existing production contract for this period of time.

When General Lincoln, General Colglazier, and others were here the other day, I raised the question, and it did not seem to make any

difference to them that there was this potentiality of another 3 months break in production, because they were going to crank in some new improvements in this second round, or this second version.

Is not that precisely what you are complaining about and why are we doing it in this case?

General TRUDEAU. It is to some extent. This is a production contract. I do not know the details of the problem if any they are running into that would require retrofit or inclusion of improved components in this case. It could be a part of the timelag; yes, sir.

Mr. FORD. If this does happen, you are going to lose 3 months production and I assume that the 3 months production right now, from what we have heard about the need for modernization of the Army, is important.

Secondly, if they stop one production line and start up another, even though the second line goes to the same party, that is now producing the first, you are going to have more costs?

General TRUDEAU. This is expensive.

Mr. FORD. That is right. Then why are we doing it in this case?

General TRUDEAU. I do not know, particularly when our total tank production is less than the number of tanks furnished by the Russians to their satellites and allies each year.

Mr. FORD. In my opinion, from what I know about it, this is a precise example of what you are complaining about. I have yet to find any justification for what is being done.

General TRUDEAU. I cannot address myself extensively to it because it is on the production side.

Mr. FLOOD. If the gentleman would yield, I agree with my friend on this tank business. In addition to that, I am advised, and you stated—either you or General Wood stated in your affirmative statements here, and we all know—that within the next 4 years we are going to start on the next generation of tank and we will have the same thing all over again.

There is no reason for this.

AIRCRAFT PROGRAM AND ARMY AIRCRAFT REQUIREMENTS REVIEW BOARD

Mr. MAHON. I believe you are requesting $36 million-plus for aircraft development and yet, as I understand it, your aircraft development plan has not yet been approved.

General WOOD. Let me clarify that, Mr. Chairman. You are quite right that the total is $36 million. In discussing this with Dr. York's office last fall, of that $36 million, $23 million is tied to items in which there is no argument at all. It has to do with, among other things, the continuation of the CHINOOK work which I described this morning and the IROQUOIS which I did not, but described last year. There is also the engine program and general research in aircraft.

However, the point raised by people in OSD was that since they knew that we were working on a long-range aviation program, we should hold up specifying in detail approximately $13 million out of the $36 million which was carried as "mobility aircraft" studies or work until we finished this work of the Army Aircraft Requirements Review Board.

As I outlined this morning we went out to industry and asked for ideas in three particular areas where we thought we could profit by industry suggestions.

The first was what we called a light observation aircraft. At the present time we have in the Army three aircraft serving this purpose; two helicopters, H–13 and H–23, and one fixed-wing aircraft, L–19. All of these aircraft are over 10 years old so that, as far as the state of their art is concerned and before we will be able to replace them, they will be 15 years old.

Since it is generally believed that airplanes, so far as their design criteria are concerned, are good for a maximum of nine years, then it is time we did some looking into this area to come up with an aircraft to replace these three in the period 1965 to 1970. That was the first area we looked at.

The second area was manned surveillance. There we were thinking about something for the latter part of this period to replace the MOHAWK now being tested. Such an aircraft would be valuable if it were necessary to do deeper penetration surveillance with a manned aircraft than the MOHAWK can do.

The third area was a transport aircraft hopefully to combine both the VTOL and STOL characteristics on the basis of tests we have had with research aircraft. We have finished funding these test beds and are now evaluating them to see what ideas we can get out of this program.

Such an aircraft would replace, in the latter part of this decade, the CHINOOK which is the helicoper for tactical transport and the CARIBOU which is the fixed-wing aircraft for this purpose. It was agreed with the Office of the Secretary of Defense that the results of this Board would be transmitted to OSD early this spring in order to spell out accurately what this $13 million would be spent for. The Board has completed its work. I was on it and that is the reason I have a lot of this in my mind.

It was a Board of ten general officers and we met from February 29 until last Friday when we presented our recommendation to the Chief of Staff. Of course, they now have to be presented to the Secretary of the Army and to the Secretary of Defense's Office. Our plan runs along this line for this $13 million: To initiate development in 1961 of this new light observation aircraft which I described as essential to replace the three which are at least obsolescent if not obsolete. This aircraft will be built around a new gas turbine engine which is presently under development. It promises considerable success because it has considerably less weight per pound per horsepower. That, we reckon, would take about $4 million out of this $13 million for 1961.

Mr. MAHON. You can extend your statement for the record if you wish.

General WOOD. Yes, sir.

(Further information follows:)

Based on the recommendations by the Army Aircraft Requirements Review Board, the $13.8 million will be used as follows:

Four million dollars, as I stated before, will be used to initiate the development of a new light observation aircraft ultimately to replace our current aircraft in this category, i.e., the L–19, H–13, and H–23. The remaining $9.8 million will be utilized to fund the following projects:

1. Studies and tests on aircraft survivability over the battle area at low altitudes and relatively high speeds.

2. Studies of the requirements for airlift to support Army contingency plans.
3. Development of V/STOL research aircraft for technical and field evaluation.
4. Study and tests on noise level and downwash problems.
5. Long range research to improve helicopter performance.
6. Research on propulsion systems.
7. Research on ground effects machines.

AIRLIFT

Mr. SIKES. May I ask a question in connection with the whole airlift problem?

Mr. MAHON. Yes.

Mr. SIKES. The morning newspaper quoted Mr. Rivers of the Armed Services Committee as saying that there are presently 27 planes immediately available for airlift. We know that the Lebanon Airlift operation taxed all of the airlift resources of our country and there was no fighting. It was about the limit of our capability. We know that the one that is going to take place in Puerto Rico in a few days is going to be carried on, in part, by contracting for CRAF planes.

Does the Army make any effort to get the problem of airlift insofar as it applies to aircraft for airlift into the hands of the Army?

General TRUDEAU. The answer is no.

Mr. SIKES. Why not?

General TRUDEAU. We are still sticking by the policy decisions of 1956 in this connection.

Mr. SIKES. Why do you not seek to get those policy decisions changed?

Mr. FLOOD. You do not mean the Key West agreement?

General TRUDEAU. That is part of it, Mr. Flood.

Mr. SIKES. Why does not the Army make a fight to get away from that outmoded arrangement?

General TRUDEAU. The Army is only a component part of national defense. While we have been given exceptions to the empty weight limitation of 5,000 pounds on fixed wing aircraft, and 20,000 pounds limitation on rotary wing aircraft—and we have had exceptions, such as the Caribou and the Mohawk—nevertheless, the existence of limitations is inhibiting as far as the development of aircraft is concerned.

Mr. SIKES. Apparently the Army accepts this ruling and takes it lying down and makes no effort to get this ruling changed insofar as this policy is concerned?

You are not going to have a satisfactory airlift capability until it is in your own hands.

General WOOD. I recall the committee discussed this at some length with General Lemnitzer. He has been the principal witness before the Rivers committee. I have not attended those meetings, but his thinking, so far as I can see, and his actions for the immediate future, are along the lines that I think he told you about, that is, he is working with General White. Both he and General White have gone down to Langley and Fort Monroe where the two responsible headquarters are located—Tactical Air Command and Continental Army Command—and I think you could describe his objective for the moment is to have the Air Force pick up the ball and do its mission. Only when and if he fails in that endeavor, will he decide to do something else.

Mr. FLOOD. If the gentleman would yield, for 10 years I have been pounding this cloth on this table here about this whole subject and got no place.

You mean to tell me that finally in this year of our Lord 1960, St. Patrick's Day, they are finally going to decide maybe we have got an airlift problem?

Is the Army going to make any fight to take from the Air Force this whole problem of airlift?

Mr. MAHON. General Lemnitzer has done a good job in telling us the Army view and I think we have to rest on that until we see.

General TRUDEAU. He is struggling hard to see if he can get the restrictions withdrawn. They are inhibiting.

Mr. FLOOD. Mr. McElroy told me here one of the last times he was making an appearance before he left, that on his desk was the consideration of revoking the Key West paper and that is over a year or so ago.

General TRUDEAU. Someone did not get the word, I guess.

Mr. FLOOD. I am suggesting, and Mr. Sikes is suggesting, that somebody should get the word and I think the burden is on the Army.

Mr. MAHON. Somebody must take the message to Garcia.

Mr. FLOOD. Or to Gates.

RELIABILITY OF CHINOOK HELICOPTER

Mr. MAHON. Do you have any reason to believe that the Chinook about which you have testified, will be more reliable and require less maintenance than the helicopters presently in use?

General TRUDEAU. Yes, sir; we do.

It is a new helicopter and the reliability of components will be greatly increased.

Mr. MAHON. It is true that helicopters have frequent mechanical breakdowns and are costly to maintain. I guess that statement is probably an understatement.

Do you have any development programs that will really do something about this?

General TRUDEAU. Yes, we do. In connection with the development of helicopter engines, the reliability factor that is being put into the new turbine engines will eventually give them an overhaul period exceeding that of current reciprocating engines.

The helicopter was new to the Army in 1952 as far as use was concerned.

Mr. MAHON. Please elaborate on that for the record.

(The information follows:)

In considering helicopter maintenance it must be realized that, as I just mentioned, the helicopter is relatively new in concept as well as development. Most of our current inventory is made up of helicopters designed with little known military requirements or experience in mind. With our new turbine engines, longer service life components and past experience factors integrated into our new helicopters, such as the CHINOOK, which are designed specifically to meet Army requirements, the ratio of maintenance hours to flying hours will continue to decrease.

The IROQUOIS helicopter is a typical example. This helicopter, which was designed to meet specific military requirements and is powered by a turbine engine, has needed the smallest amount of maintenance of any military helicopter in its category. This trend will continue to be evidenced with future military helicopter developments such as the CHINOOK.

Specifically, in helicopter research and development we are directing our efforts toward continued improvement of components to increase service life and incorporation of past experience factors into the design and development of new machines. We believe that our research and development programs combined with basic operating experience will continue to improve the state of the art until the helicopter will approach the conventional airplane in ease of maintenance.

GOER VEHICLES

Mr. MAHON. Compare the cost of the GOER type vehicle which you demonstrated in the movie with a comparison on a standard Army truck of the same capacity.

How much more expensive is the GOER?

General TRUDEAU. I would like to say this about the GOER: The 15-ton GOER we have now is going to cost about a dollar a pound. And, as I say, there are no military components and no special peculiar specifications put into it. In other words, for a 15-ton capacity unit we are going to pay about $30,000. It is the equivalent of six 2½-ton trucks which cost $8,500 apiece. Thus, you are going to get for $30,000 a vehicle which can carry the equivalent of $50,000.

If you want to consider that you have a driver and assistant driver, you save 10 men out of 12, or 5 out of 6, if you have an assistant driver. This is money in the bank. It will not replace all trucks as far as high density vehicles that go down the road are concerned, but the truck today has no offroad mobility. The GOER has great potential.

IMPROVED RIFLES AND OTHER SMALL ARMS

Mr. MAHON. You mentioned improved rifles and other small arms soon to be operational which out perform our present weapons.

The 7.62 rifle is operational and there is another improved rifle assumed to become operational. If so, what is the comparison?

General TRUDEAU. We have taken a new approach to this. Most of us considered the M–14 only a product improvement over the Garand. Consequently, we have started from the beginning to find out what was necessary to inflict a sufficiently serious wound on an enemy and at what range. We have been trying to get away from the concept which has largely been controlled by expert riflemen of the National Rifle Match caliber who think you must hit the bull's eye at 1,000 yards. We want to get down to something that has a killing capacity in the range where the infantryman closes in with the enemy—up to 500 yards, but very seldom more.

Mr. FLOOD. Killing or disabling?

General TRUDEAU. Killing, disabling; in the same ballpark, as far as putting him out of action. It is true that you might have to have sniper rifles of other caliber.

(Discussion off the record.)

General TRUDEAU. These tests are going on and I saw them in the Arctic only 2 weeks ago and they are being carried out at Aberdeen and other places.

It is a conventional type cartridge, then we are going to build a rifle around that as small and as simple as we can. We believe that in the future, by 1965 or so, we can come up with a rifle and 750 rounds of ammunition that will be no more of a burden to the soldier than the present M–14 and 160 rounds of ammunition.

This will be a real step forward.

Mr. MAHON. You are doing some very objective, rather imaginative thinking on this.

General TRUDEAU. I hope so.

Mr. FLOOD. Will that be discharged pneumatically or by conventional powder?

General TRUDEAU. Conventionally. But we do not have our eyes closed to the possibility of other things as to how it will be discharged.

TARGET DRONES

Mr. MAHON. Each service talks about drones. Is it true that each service must have its own drone airplanes?

General TRUDEAU. Not for the same purpose. I think that most of them, you will find, that are used are conceived for different purposes. For instance, in the Army the drones we use for target purposes have to be different than those used for surveillance. In other words, we want a drone that will go to 100,000 feet if we are to be able to demonstrate with NIKE-HERCULES against it.

In the surveillance field, you saw the SD–2 drone which is cheap and which can be produced and used by front line troops. You saw two other types with different characteristics, although the speed of these latter two is somewhat the same. We hope that as a result of the knowledge we will gain during development that we can concentrate this into just one system, with several capabilities, but whether it can be done or not, we are not sure.

Mr. MAHON. Do you feel that we could consolidate these target drones, the research and development work on these, between the services to a greater extent and do the job better and more cheaply, or not?

General TRUDEAU. I do not think so, from the knowledge that I have. There is collaboration with both the Navy and Air Force on drones. As a matter of fact, I think it is still under rather intensive study by Dr. York's office.

Mr. MAHON. What are the characteristics of the newest target drones used by the Army in testing air defense?

General TRUDEAU. I would say that General Dick is best qualified to answer that.

General DICK. The latest drone, Mr. Chairman, is the so-called Q–5. This was an Air Force product and is the one we used to test the HAWK and HERCULES.

It can go to about 70,000 feet and it travels at speeds better than mach 3. This is the best to date for high altitude work and it is recoverable. We would like to have them faster and higher.

MEDICAL RESEARCH

Mr. MAHON. Some reference has been made to humanities and to medical research and so forth.

Is the Department of Health, Education, and Welfare performing any medical research for the Army?

General WOOD. I think not specifically military research.

I will ask General Ely, who is Director of Research, to comment on this. In the medical field, it seems to me, there is a closer coordina-

tion and exchange of ideas, both in military medicine and in civilian medicine, than in almost any area. It is the nature of the medical profession.

The Army is emphasizing in its program only areas that are important to military medicine. For example, we do not do any cancer research, important as it may be to the Army which loses people by cancer, but this area is tremendously funded by civilian agencies.

We work only on military problems.

To answer your specific question, I think not.

General ELY. I do not know of any contracts, but I want to reiterate what General Wood said, that there is a coordination in the medical field with the National Institutes of Health, with Health, Education, and Welfare, and all the agencies involved. This is the best that we have anywhere in the service.

Mr. MAHON. Do you have coordination with the National Institutes?

General ELY. Very, very active coordination.

Mr. MAHON. Do they do any work for you without reimbursement?

General ELY. The coordination I speak of is the fact that there are committees on committees on committees in all of these medical fields and we have people sitting on these committees. Of course, there are no funds involved in that type of coordination.

RESEARCH ON AUTO ACCIDENTS

Mr. MAHON. You are talking about not doing cancer research, General Wood. One of the services some time ago was investigating automobile wrecks in order to find out just what happened in these situations. Who was doing that, the Air Force?

General TRUDEAU. They have a very extensive program on cockpit safety.

General WOOD. We were part of the initiating group, but are now phasing out as the National Institutes of Health continues the studies.

Mr. FLOOD. I thought it was Highway No. 1 to Baltimore.

Mr. MAHON. I understand this work was done for the purpose of making driving more safe because the services were losing men as a result of automobile accidents more than as a result of anything else.

MANAGEMENT AND OPERATIONAL CONTRACTS FOR RESEARCH

Are any Army research facilities operated by companies under management and operational contracts? Will you elaborate on that?

General WOOD. I do not understand the question.

Mr. MAHON. Do you have management contracts at certain facilities?

General WOOD. I know of none.

General ELY. I know of none.

General DICK. None.

General TRUDEAU. I know of none.

Mr. MAHON. The Air Force does quite a bit of work like that at Canaveral and at Arnold Engineering in Tennessee, and so forth.

General TRUDEAU. Yes, sir; they have a great deal.

Mr. MAHON. What is the Army's philosophy with respect to running facilities by this contract method which uses private industry?

General DICK. We have an example, Mr. Mahon, which may be along the lines you were thinking of. The north half of the instrumentation setup at White Sands Missile Range is let on contract for operation. As I think was mentioned this morning, we plan to have some of the Fort Huachuca electronics testing range run by contract. This is the sort of thing you are talking about. We do do some of that by contract to industry.

Mr. MAHON. Give us some other examples for the record in that type of operation.

General DICK. Yes, sir.

General WOOD. I do not know of any except those ranges.

General TRUDEAU. It is an operational contract.

Mr. MAHON. Did you have any further comments?

General LINCOLN. I was attempting to clarify this. It seems to me these are all contracts for operation of a facility rather than overall management. Management would stem from the military command in other facilities.

(The statement referred to follows:)

USE OF MANAGEMENT-TYPE CONTRACTS BY THE DEPARTMENT OF THE ARMY

The Department of the Army awards contracts to augment supporting activities and provide technical assistance in operating facilities. For example, at White Sands Missile Range the upper portion of the integrated range, beyond the 40-mile impact area, is contractor operated. Land Air, Inc., provides data collection service while Telecomputing Service, Inc., provides data reduction service. However, the Department of the Army does not have any contracts requiring managerial control or technical direction by a contractor over other defense prime contractors, or which vest in the contractor the use of discretionary authority required to be exercised by an official of the Government.

QUARTERMASTER FOOD AND CONTAINER INSTITUTE

Mr. MAHON. One of the Members of the Committee on Appropriations has called to my attention what appears to be an Army plan toward moving the Quartermaster's Food and Container Institute from Chicago to Massachusetts. The committee staff has made a preliminary investigation into this move and apparently some military construction is involved.

Can you make a statement on the reasons for this proposed move?

General TRUDEAU. I would like to have General Ely address himself to that.

General ELY. It has been handled in connection with the military construction program. However, as I understand it, the reason behind the move is the very high cost of the facilities now occupied by the Food and Container Institute in Chicago plus, from our point of view, a very much more desirable setup in research and development. If this unit could be moved to the Quartermaster Research and Engineering Center at Massachusetts this more desirable setup would result.

Mr. MAHON. Are you actually going to make this move?

General ELY. As I understand it, this is now awaiting a GAO report which is to be submitted in the near future. It is before the Congress. It was taken from the authorization bill, as I understand it, without prejudice and it may or may not be done.

This is the authorization for construction and it may or may not be put back in before the Senate.

BASIS OF CONTRACTS

Mr. SHEPPARD. Mr. Chairman, I will not take too much of your time because you have gone into several subject matters in your direct interrogation which I was interested in.

I was confronted with the shopping list which presumably everybody else had to digest during your conversations, but I would like to ask you gentlemen the following questions:

Is this section of the Army following the policy of placing orders with producers who have large backlogs or other sources in being?

General TRUDEAU. If it is a fixed-price procurement contract you have no leeway on that.

Mr. SHEPPARD. Why do you not have leeway?

General TRUDEAU. Because you give it to the lowest bidder.

Mr. SHEPPARD. Am I to interpret from your answer that all of the contracts that are on your shopping list here are done on a competitive bid status?

General TRUDEAU. No, sir, most R. & D. contracts are negotiated.

Mr. SHEPPARD. What percentage of the total reflected here on three pages of your shopping list would be in the category you have just referred to as against other types of contracts?

General TRUDEAU. We will have to get that for the record, Mr. Sheppard.

Mr. SHEPPARD. Very well.

(The information follows:)

Procurement information on Army research and development

Contracts for 1st half fiscal year 1960	Number	Percentage
Total R. & D. contracts $10,000 and over awarded	1,250	100.0
R. & D. contracts advertised	2	.1
R. & D. contracts negotiated	1,248	99.9
Total negotiated contracts	1,248	100.0
Type:		
Cost plus fixed fee	738	59.0
Fixed price	89	7.0
Cost (no fee)	391	31.0
Others	30	3.0

FUNDS FOR COMPLETION OF PROJECTS

Mr. SHEPPARD. In order that I may have the record as clear as I can, so far as I am concerned, I am going to ask about some figures reflected elsewhere.

What is your total requested for funding in the present budget we are considering here?

General WOOD. $1,041.7 million NOA.

Mr. SHEPPARD. Out of that total amount, if it is all granted, how much is to be applied to completion of projects started in previous years?

General WOOD. I will have to break that out for you, sir. I do not have it in that form and I would hate to guess at a percentage.

Mr. SHEPPARD. Very well.

(The information follows:)

R. & D. projects generally continue for several years. Since the budget contains funds required for a fiscal year, there are relatively few major completely new projects per se started in any fiscal year. Another contributing factor to the small number of new projects in any 1 fiscal year's budget is that small dollar value projects, for budgetary purposes, are consolidated into fields of interest such as research and development of radios, environmental research, and so forth. Also new R. & D. projects normally start with relatively small amounts of money generally devoted to research, and/or feasibility studies with expansion in subsequent fiscal years into development. Accordingly, most of the funds requested in a particular fiscal year's budget will be applied to projects which were started in previous years. Of the funds it is estimated that approximately 95 percent requested in the fiscal year 1961 R. D. T. & E. budget for the Army's program, will be applied to projects started in previous fiscal years. The remaining 5 percent will be applied to new projects starting in fiscal year 1961.

NUMBER OF MISSILE SYSTEMS

Mr. SHEPPARD. There is one other question I would like to ask you: It has occurred to me and perhaps erroneously, in talking about your missile operations in its entirety, in response to Mr. Mahon, there seems to be rather a prolific number of systems involved. What is the principal procedure in having so many missile systems, as such? I know there must be some good reason for it and I would like to know what the reasoning may be back of it.

General WOOD. I would like to divide it into two areas: Surface-to-surface and surface-to-air.

In the surface-to-surface field, we are moving toward a family of only four systems; one for the battlegroup level; one for the division level; one for the corps level; and one for the Army level. That means a difference in their range. The last two, the SERGEANT and PERSHING are in development and are past the research and development peak of funding. They will be available in ——— respectively.

In the shorter range field, we already have, or will have shortly, HONEST JOHN, LITTLE JOHN and LACROSSE. We believe that in these first-generation missiles, we have learned enough to come up with not more than two systems in the future to replace those three.

The SERGEANT, of course, replaces the CORPORAL. The PERSHING replaces the REDSTONE and retires the first generation missiles. These larger caliber, longer-range weapons, REDSTONE and CORPORAL are liquid propelled, as you know. The development of solid propellants has enabled us to have much more maneuverable and mobile systems. We feel that we need a family of four missile systems for the different combat units which I mentioned, just as in the old days we needed artillery of different calibers and small arms weapons, too, to give each individual and unit a weapon with a range appropriate to its use.

In the surface-to-air field, we have two problems. One is connected with the defense of the Army in the field and one connected with the defense of the continental United States, both being Army missions.

In the latter category, we have developed AJAX as you saw this morning, and as we learned more we felt that we had to have a missile with a greater potential, particularly against flights of aircraft rather than individual aircraft. So we developed the HERCULES. We

reckon that those missiles are adequate for the high altitude aircraft threat, the air supported threat, so far as defense of this country is concerned. We contemplate that the next step will be an antimissile missile which is the ZEUS.

When you got into the field, in World War II and in Korea, we had a family of air defense weapons which started with the single 50-caliber machinegun. It was mounted on top of trucks and was essentially an individual weapon for all arms, not just for antiaircraft units.

Above that we had the 40-millimeter Bofors which was for mobile units in the forward area. Behind that we had the 90-millimeter and 120-millimeter guns.

Mr. SHEPPARD. I get your explanation, I do not want to cut you off, but when you have enough, it is enough.

General WOOD. Yes, sir; we are replacing those guns with the surface-to-air missile system I described this morning—REDEYE, HAWK, MAULER, HERCULES and the field Army ballistic missile defense system.

Mr. SHEPPARD. What you are actually doing here, and I interpret a procedure, is to use the first generation for satisfying exploratory requirements, if I may use my terminology, and generating from that the more positive operational factor in the second generation; is that reasonable as a conclusion?

General TRUDEAU. That is the result that comes from it. There was a real operational requirement for the first generation.

General WOOD. That is right.

REFINEMENT OF EQUIPMENT

Mr. SHEPPARD. In view of that procedure and in view of the fact that much controversy broke loose on Capitol Hill and perhaps some other places over where we are as compared with another nation, I would think that somewhere along the line somebody ought to be applying the philosophy the General quoted this morning, which to me is a very worthwhile one, and I quote it again for the benefit of the record.

The better is ever the enemy of the good.

When are we going to drop away from the second generations and begin having more operational equipment, gentlemen, and drop the potential refinements until we are prepared with a lot more than we presently have? What is the thinking so far as you gentlemen experience that thinking? Maybe not of your own, but you have to interpret that through others, and does there seem to be any line of demarcation approaching this situation of advancement, advancement, advancement, or what?

General WOOD. We look as far forward as we can, Mr. Sheppard. Sometimes the crystal ball is not very clear, as you and I know. Of course, there are two factors which are pertinent to this. One is the so-called state of the art which means the results of this exploding technology we are in and which has shown more advancement, I am sure you will agree, since World War II than in any previous era in the world's history.

The second factor is, what the other fellow has, or may potentially bring against you. With this in mind, we think that our missile program—what is in hand and what is in development, or what is visualized—is a pretty good program for this decade which is now starting.

I would hate to say what those two factors I mentioned might develop into after 1970.

REVIEW OF R. & D. PROJECTS

Mr. SHEPPARD. While we are discussing this issue, it is rather interesting as far as I am personally concerned, but if I may at this point address this question to you, General, because I think you are closest to it, how many actual reviews take place in the establishment of a usable missile from the time of its inception up to the time the Department of Defense, or whoever is in a position to do so, says, "This is as far as we are going"?

How many steps are taken in there, administratively speaking?

General TRUDEAU. This never ceases. That is the only answer I can give you.

Mr. SHEPPARD. It is the perpetual motion thing we thought we could not conquer.

General TRUDEAU. There is another review made every time you need any more money or need to change your program. These are the time factors that get cranked in.

ELECTRONIC ENVIRONMENTAL TEST FACILITY

Mr. SHEPPARD. May I please intrude for the purpose of a little repetition? I wish you would define for me what you are actually going to do and what you have done in the Fort Huachuca. What are you actually going to accomplish there?

General WOOD. As I tried to explain, what we are setting up is a field laboratory, an area which will start off roughly 60 miles on the side. For certain purposes it will be greater than that.

For example, the drones we are going to use for testing in this area will probably fly from Yuma to Huachuca, which is a distance greater than 60 miles.

Mr. SHEPPARD. I know that you are going to do certain things, may I say subsidiary things, but the basic principle is that this is there for what purpose?

General WOOD. The basic principle is to set up an instrumented range at which we can test the equipment which we now have in inventory, plus items in research and development that are coming out at the same time, and against each other, shall we say, to simulate a situation which a division may experience in the field when all of its electronic gear is working and the enemy's is working, too, to see if the things will work and be compatible with each other. We will also want to see how much of our materiel he can jam, and prevent working.

We have tried to do this in two ways in the past; first, by testing individual equipment in what we call our engineer and user tests; secondly, in the field maneuvers such as we have in the States.

In the first case, you are testing only one or two items at a time, and in the second case, you have a maneuver which is controlled for other

purposes, tactical operational purposes, and not controlled with a view to getting the answers we want, so far as electronic compatibility is concerned.

Mr. SHEPPARD. Operationally speaking?

General WOOD. Yes, sir.

Here we are going to set up a field laboratory at which we can make this test. One reason for using Huachuca is that it is an area where there are not too many civilian electronic devices, such as you find near large cities.

Mr. SHEPPARD. In other words, you are trying to keep away from interference as much as you can?

General TRUDEAU. Yes, sir. In addition we have no land to acquire down there.

Mr. SHEPPARD. I can understand that under the circumstances. Where does the actual testing of the appurtenances in these missiles take place?

General WOOD. Where does the testing take place now?

Mr. SHEPPARD. For the internal gagdets that go into these birds?

General TRUDEAU. These are tested during development as well as at the missile range at White Sands.

Mr. SHEPPARD. What has been so far your experience in failures resulting after those inspections have taken place? What percentage?

General WOOD. I think it is true to say that in every R. & D. program we have failures of parts of our equipment which we work out during the program and turn out with a missile system that works. We have not turned out any system to the troops, and will not turn out a system to the troops, that does not work. But in any electronic device there are problems. Take simple radios with which you are familiar. They are tuned on a certain frequency; but as you know, they lap over into other people's frequencies, quite often, and they also have a phenomena known as skip, whereby today in your car you might pick up a station from Chicago much more readily than you do one from Washington.

I mean that kind of thing is something you cannot necessarily predict when you devise a system for a specific purpose until you test it, we hope, in this area we are talking about.

Mr. SHEPPARD. Even though you get it there, it is still subject to the idiosyncrasies of those interjections that take place?

General WOOD. Yes, sir.

We hope to learn enough about it to guard against them.

LACROSSE MISSILE

Mr. SHEPPARD. There was some inquiry here this morning about the LACROSSE.

It has been by conception, and perhaps again I was wrong because I would not attempt to place my judgment against that of my experienced colleagues here at all, but I was advised by the people who were in the field and personally associated with that operation, that while LACROSSE had been a headache and had given us certain troubles, nevertheless there had been a lot of compensating factors emanating from its production up to now where you learned your lesson and did not repeat your errors; is that true?

General TRUDEAU. We think it is true.

Mr. SHEPPARD. You ought to know because you are right up against that.

General TRUDEAU. Let me say we have not had a repetition of difficulties we corrected. That is the proof of the pudding.

Mr. SHEPPARD. That has contributed to some degree, at least, to the perfection or semi-perfection, of the other birds that have come along?

General TRUDEAU. Very considerably.

QUALITY CONTROL

Mr. SHEPPARD. Is that not pretty generally the process you have to follow in a field of unknown factors you have been dealing with over a period of a long time?

General TRUDEAU. Yes, it is. One of the problems with all of our firms today is because of the nature of the new work they are undertaking and the difficulty of getting really qualified people who are thorough. This question of quality control in inspection is one of the toughest problems that industry has and we have. This is where the failures come in.

Mr. SHEPPARD. Have you had any opportunities to surmount that particular problem, or will you have within the next 2 or 3 years?

General TRUDEAU. Only by improved inspection procedures and improved upgrading and training of individuals.

Mr. SHEPPARD. Is that being done by the military and civilian both, to your knowledge, at the moment?

General TRUDEAU. Both. This is one of the reasons why we put a lot of value on what we are sometimes criticized for, in the inhouse system. We feel we need enough capability in our arensals, or laboratories, not only to design but also to be able to inspect and be able to evaluate costs and to understand inspection with respect to quality control.

Mr. SHEPPARD. Because of the delicate requirements on the issuance of your contracts in these fields, what part of analyzing a prime contractor is concerned with the personnel he has and the know-how within that institution?

General TRUDEAU. This is an important factor, but it is only one of seven or eight evaluated. The technical capability and leadership of the firm or project engineer or director, let us say, is an important part.

PREREQUISITES OF FIRMS SELECTED FOR R. & D. CONTRACTS

Mr. SHEPPARD. Would you be divulging something detrimental if you were to place in the record at this time the prerequisites of the firms you select to do this type of research and development production for you?

General TRUDEAU. No; I do not think so. I think that could be done.

Mr. SHEPPARD. It never has been done, to my knowledge, and if it is not detrimental to the record, I would appreciate that at this time.

General TRUDEAU. I will give you a paper with some thoughts on that subject.

Mr. SHEPPARD. Thank you very much.
General TRUDEAU. Thank you, Mr. Sheppard.
(The information follows:)

AWARD OF ARMY RESEARCH AND DEVELOPMENT CONTRACTS TO CONTRACTORS WITH EXISTING LARGE WORK BACKLOGS

Determination as to whom an R. & D. contract shall be awarded is made after consideration of several factors, including technical competence, costs, managerial capability, and past performance. Consideration of the technical competence of prospective contractors takes into account the contractors' understanding of the scope of the work as evidenced by his proposed scientific or technical approach to the problem, the availability and competence of experienced technical and scientific personnel, the availability of necessary facilities, the experience or pertinent novel ideas advanced in the specific science or technology involved, and the contractor's willingness to devote his resources to the proposed work. Since the availability of the prospective contractor's resources as well as his willingness to devote these resources to the proposed work are carefully weighed, no R. & D. contracts normally would be awarded to contractors who have large backlogs of work.

HAWK INTERCEPTION OF HONEST JOHN

Mr. MAHON. Mr. Sikes?

Mr. SIKES. I thought the achievement of the Army in using the HAWK to kill an HONEST JOHN missile was a very significant one which could offer much promise for the future. Nevertheless, one prominent scientist said to this group subsequently that he did not doubt the ability of the Army to do this since you were controlling both ends of the operation. He said to move this capability on to the battlefield, where you would only control one end of the operation and where you would have the inevitable confusion which goes with a battlefield operation, he did not know what value could be ascribed to that achievement insofar as its usefulness on the battlefield conditions are concerned.

Would you speak to that?

General TRUDEAU. Well, I can only say that this intercept presented unusual problems because the target missile itself, during its short time of flight, was tracked from the time the HAWK radar scan first picked it up in flight to the time it was fired at, a matter of ——— seconds, which I think is impressive.

We believe that the radar we have developed in connection with the ZEUS is going to reach out and give something in the neighborhood of ——— for this intercept. All of these actions will be taken, of course, after acquisition through the computers and others methods, so we feel very optimistic about that.

As a matter of fact, we are going to continue some additional shots of this type, using higher velocity target missiles and at longer ranges. The collision speed of these two missiles at intercept, was about 2,000 miles an hour.

We see no problem in a ballistic missile which is something coming down a one-way road.

In doing it at 4,000 or 6,000 miles an hour, it is all relative.

MOBILITY OF WEAPONS SYSTEMS

Mr. SIKES. I wonder if you would speak on the degree of mobility in weapons systems which we have now developed. I think mobility in our weapons system is extremely important and it is essential we have mobility. In some weapons we do not possess mobility. What major weapons do we—and I include tanks, trucks, and other equipment—do we not now have mobility, and what emphasis is being placed in this year's program to achieve it where we do not have it?

General TRUDEAU. In an Army weapons system, this is always a prime factor. I know of no missiles—and I think this is probably what we are considering here—I know of no missile in which we have not provided for real mobility. For instance, HONEST JOHN and LITTLE JOHN can be helicopter borne. The HONEST JOHN can be carried by plane and we have done that many times. The LITTLE JOHN, of course, can also be transported in a plane.

The PERSHING which has the extreme range, will be mounted on the M–113 armored personnel carrier and, therefore, will have cross country mobility.

The LACROSSE and SERGEANT are both mounted on wheeled vehicles and that will give rather good mobility. Our new aircraft now in development will be able to transport all of the missile systems.

Mr. SIKES. You know the criticism that is directed at our airborne divisions. It is said they just do not have staying power on the battlefield because they cannot take enough equipment into position with them. What in this program are we doing to give airborne divisions more staying power?

General TRUDEAU. One objective here is to get sufficient strategic airlift to carry more of the vehicles and equipment necessary to provide staying power.

Mr. SIKES. I know that, and I recognize that weakness.

General TRUDEAU. The next one is to lighten the equipment.

AIR TRANSPORTABILITY OF EQUIPMENT

Mr. SIKES. That is the one I want to get at now.

What are you doing in this year's budget program to lighten equipment so that it can be airborne and you can take it in with airborne units?

General TRUDEAU. I do not know of any weapon we have that is not capable of being airborne. What bogs down these units to a considerable extent is the inability to transport the large number of trucks or armored personnel carriers they have. When I say "weapons" I should make an exception to the main battle tank because we do not ever maintain that the tank is airborne and it may not be airborne unless we can get one down to 15 or 20 tons in the future. This is a problem.

Many of us believe that with the advent of these missiles, and perhaps with a newly acquired capability in the air to move slowly and relatively quietly, just above the surface of the earth with the family of aircraft cheap, light vehicles we are thinking of, and perhaps some day have the authority to arm them the way we want

to arm them, that this may lead to an entirely new tactical concept that would free the forces in the field from the need of 2,000 trucks, 200 tanks, and so forth.

These are along the lines we are trying to look forward to. It is true that by the use of aluminum and titanium, and other alloys we can lighten the weight of some of our vehicles. In the long run, we are looking forward to greater changes in the organization and tactical concepts.

This latter point is not primarily my problem. I am a hardware man, but we cannot stay away from this.

OVER-THE-BEACH CAPABILITY

Mr. SIKES. Is there anything in this budget which will improve our over-the-beach capability in the light of conditions associated with atomic warfare?

General TRUDEAU. The main things are the LARCS we have described. They are amphibious vehicles that have proven out to be highly successful in their test and evaluation program.

Mr. FLOOD. Would the gentleman yield?

Mr. Sikes' question was atomic warfare, not just over-the-beach, but over-the-beach in an atomic war.

General TRUDEAU. Of course, the armored personnel carrier itself is floatable. This is the best type of protection you can give people.

Mr. FLOOD. From an atomic blast and radiation?

General TRUDEAU. Yes, sir. Not so much protection from radiation. There is a definite limit on that.

RADIATION PROPHYLAXIS

Mr. SIKES. Since you mentioned radiation, I was interested in your statement about efforts to develop a chemical prophylaxis of radiation exposure. That is something extremely important.

How deeply are you getting into that field and how much promise do you see in it?

General TRUDEAU. We have carried it into animal research and the result was that, where the dosage has been given to animals, that those were given the benefit of this protection lived and those that were not, died.

We know that it is that good.

How to transit from the testing of animals to man is another question. We believe that there are tremendous possibilities.

This is a very important field and it is just as important to civilians as it is to the man in uniform.

Mr. SIKES. In field of pure research, it is difficult to include a time factor on it, but would you make an estimate of the time it appears will be required to come up with an answer in this field?

General TRUDEAU. This would certainly be risky, and I would be just picking a figure out of the air, based on the best knowledge I have. I would say that to defend against radiation, I believe within 24 months we will have made progress to the point where it may provide knowledge leading to practical application.

Mr. SIKES. This may be one of the most important things you are going to do?

General TRUDEAU. It could well be, we agree.

Our Medical Corps is working with every medical facility in the country to try and resolve this.

Mr. SIKES. Is this a general thing that is being done by a number of agencies?

General TRUDEAU. I do not know any one that is putting as much effort into it as we have, but it is quite possible. I am sure that the Surgeon General——

Mr. SIKES. It would be well for many of our agencies to work on problems as important as this one could be?

General TRUDEAU. Yes, sir.

RESEARCH ON SUNBURN AND SEASICKNESS TABLETS

Mr. FLOOD. Are you people, or is the medical group, doing research and development on sunburn tablets? I remember we started this during the war and I have heard a lot about it for years. On the old Army panel 8 or 9 years ago we used to hear a lot about this sunburn tablet and then we did not hear about it for 3 or 4 years. Is it so good that it is with troops or what?

General TRUDEAU. I do not think so. I have no personal knowledge of that. It would be with our medical service.

Mr. FLOOD. You know what I am talking about? You can buy them in drugstores now even without a prescription. Is there such a thing that has been operational and has it been in commerce for 2 or 3 years? We were talking about it back in Jim Gavin's day and since and we have not heard a thing about these tablets for sunburn for 2 or 3 years.

General TRUDEAU. I do not know any answer to that.

Mr. SIKES. Why do you not provide additional information on that subject?

General TRUDEAU. We will be glad to provide a statement for the record.

Mr. FLOOD. And seasickness.

General TRUDEAU. We have that.

(The information follows:)

SUNBURN RESEARCH

Dr. John Knox at Baylor University, supported by Army funds, is studying the protective effects of the benzophenones and oxyquinolines against short wavelength ultraviolet light (sunburn). Both groups of compounds protect albino mice when used in an ointment or taken by mouth. At this time, there is no requirement for standardization for military use.

MOTION SICKNESS RESEARCH

The Army does not now have a research program in motion sickness prevention. A compound, Bonamine, was standardized for troop use in 1958. A tri-service committee is evaluating new compounds.

CBR RESEARCH AND DEVELOPMENT

Mr. SIKES. I was interested in the fact that additional research and development funds are being made available for CBR.

How do you envision that most of these funds are going to be spent, General?

Will it be outside the Department of Defense with research institutions, universities, and industry?

General TRUDEAU. The instructions I have issued to the Army Chemical Corps limit the expansion of inhouse requirements on the utilization of these funds to not over 10 percent of the funds involved. Ninety percent will go out to industry, private laboratories, and institutions.

Mr. SIKES. Why is that? Is there that much additional know-how to be obtained from outside activities? Possibly limited funds have not permitted this procedure heretofore.

General TRUDEAU. I think that there is that much know-how to be gained outside. Furthermore, I think it would be inadvisable to have a considerable expansion of the Chemical Corps' inhouse effort and in 2 or 3 years have it tapered off again. I think we should go to industry, science, technology, and come up with the best that we can. I am sure that they have much that they can contribute.

Mr. SIKES. I want to congratulate you on the interest you are showing in this field. It is a very important one and one that has been to a considerable degree neglected in prior years. I am glad to see that you, apparently, recognize the necessity for gaining additional information and additional know-how in this field.

General TRUDEAU. The Army is grateful for your support, Mr. Sikes.

IRRADIATION PRESERVATION OF FOOD

Mr. SIKES. We were talking about radiation a few moments ago. Do I understand there is some feeling that radiation as a preservative for food may not be as valuable as we thought it would be, and it might even be dangerous?

General TRUDEAU. I would like to have General Ely respond to that.

General ELY. The Army's program has been going on since 1953 and I believe the basis for your remark is the fact that the Army took steps last October to stop construction on the pilot production plant at Stockton, Calif. and to reorient our program in the research field. We did this primarily because there were so many questions developing that indicated more research was necessary before we could hope to get into production, and because of the national interest and the interest of the Department of HEW, Food and Drug Administration specifically, in the question of additives in food.

One reason, or the primary reason, we did it, I would say, is that we found three things which come to mind on animals we have been feeding irradiated food to over the past 6 years.

While they are not serious, there are anomalies that run up the red flag. For instance, we found a large percentage of mice being fed irradiated food were having ruptured hearts and the controlled animals none. The animals that had been fed irradiated feed, a good percentage——

Mr. FLOOD. Were there any neurological, psychiatric reactions?

As you know, one of the original guinea pigs was the old Army panel.

General ELY. We have noted no such reactions in the animals. Other results were hemorrhaging in rats and indications of sterility in dogs.

We have revamped the direction of our program.

We are seeking authorization to build a research facility, a smaller facility of less scope than the pilot production plant that was in the program. At the same time that we are reorienting our program, the Interdepartmental Committee on Irradiation of Food, which consists of Agriculture, Interior, AEC, HEW, has taken steps to get underway a national program dealing in lower doses.

The Army's program is primarily directed at sterilizing doses and the other program is pointed toward civilian uses involving potatoes, strawberries, fish, fresh fruit, and so forth.

PNEUMATIC DEVICES

Mr. FLOOD. Tell us something about the new fluid amplifier. A few days ago, maybe a few weeks ago, I saw this comment: "The Army probably lifted the curtain today on pure fluid amplifiers, greatly simplified controlled devices which could launch a new industry and improve many military weapons, including missiles."

What is it? What does it do? What is the status of it?

General WOOD. I think you must be referring to what I called pneumatic devices which the Diamond Ordnance Fuse Laboratory developed.

It is believed that those scientists have discovered a principle of control possibilities using a small and low velocity jet of liquid against a higher velocity and larger jet of liquid in order to cause it to divert or turn.

Mr. SIKES. Is it a practical thing?

General WOOD. I do not know yet, sir.

It is just out of the diagram on blackboard stage, shall we say, and these people are still engaged in manufacturing some small devices in order to test the principle.

The scientists are sufficiently encouraged so we have asked the Office of the Secretary of Defense if we could have some emergency funds to pursue this breakthrough if it is that.

Mr. SIKES. I think the Army is to be congratulated for its work in this field and for its efforts to come up with something new.

Whatever you want to add to your statement, provide it for the record later, will you?

General WOOD. Yes, sir.

(The information follows:)

Pneumatic systems are widely used in military and industrial equipment, but until now there are no ways of amplifying a signal in a pneumatic system without moving parts. During the first half of 1959 members of the Diamond Ordnance Fuze Laboratories staff proved that pneumatic amplifiation without moving parts is possible. This discovery makes it possible to use pneumatic control systems, amplifiers, and computers where they couldn't be used before.

The basic idea is to use a low energy flow of fluid or gas to direct a high energy fluid or gas stream. This control action permits elements and systems capable of amplification, feedback, memory, logic functions, analog computation and digital computation. In addition, these functions can be performed with components which are extremely rugged and reliable, just a block of metal full of holes.

Through combination of the above six techniques a "pure pneumatic" analog of most electronic circuits can be designed. The staff at the Diamond Ord-

nance Fuze Laboratories have demonstrated feasibility of pure pneumatic elements which enable—

(*a*) Amplification
(*b*) Feedback
(*c*) Digitalization
(*d*) Memory
(*e*) Logic functions
(*f*) Ultralow frequency oscillation
(*g*) Zero rest
(*h*) Normal mathematical processing

These functions are the foundation for both analog and digital compution. "Pure pneumatic" models of the above have been designed and constructed as well as a sonic oscillator which appears to be relatively independent of supply pressure.

Because of the nature of "pure pneumatics" it becomes rather confusing to talk about all of the applications for which these techniques can be considered. It is similar to saying the vacuum tube has been invented, it is useful, it can be applied to systems. The technical program is aimed at development of the techniques rather than primarily for application to a particular system. The physical structure of pure pneumatic elements or computers or systems does not present any significant design problem, however, it is of particular interest. Each unit is essentially a piece of metal, ceramic, or plastic full of holes. The production techniques are relatively simple and entirely compatible with current state of the art.

There are, of course, advantages and limitations associated with any such system or technique. The limitations for pure pneumatic systems are not well established as yet. For most systems the frequency limitation appears to be less than 20 kilocycles. Data is not available to make this a firm limit. The other general limitations have to do with the current capabiltiy to design efficiently to a particular performance requirement. Final design can be achieved through successive approximations but more coordinated fundamental information is needed on the internal aerodynamic and acoustic characteristics involved.

The advantages of pure pneumatic systems are:

(*a*) Extremely rugged. One can envisage a pure pneumatic computer for the soldier at the front so rugged that he would have to shoot a bullet into the unit to render it inoperative.

(*b*) Reliable. These units are fixed in performance once they are made. Because of their simplicity as a production item the bench test takes on new significance as a complete checkout of the unit from a reliability standpoint.

(*c*) Serve large forces. The techniques outlined can serve large forces and reposition, or reorient items without relative motion of parts. It has been demonstrated that a rocket's main jet thrust direction can be controlled for thrust vector control without moving parts such as used for gimbaled motor, jetavators, or jet vane controls. This is potentially a major improvement in reliability, weight reduction, design complexity, and cost.

(*d*) Environment. Capable of proper operation during extreme environmental conditions of temperature, shock, vibration, and including a near nuclear burst.

(*e*) Easily tested. There is nothing to adjust and in the cool gas systems nothing to wear out. Because of their simplicity laboratory testing of prototypes is much more dependable as a performance predictor than most electrical or mechanical systems.

(*f*) Indefinite shelf lite. The units are comparable to the storage of raw materials or structural items.

(*g*) Very cheap to manufacture. These are throw away units similar in cost to a structural type item where cost is of the order of or less than five times cost of materials.

(*h*) High density power supplies. These units can use thermal type power supplies such as combustion type gas producers or evaporators. Such units provide at least an order of magnitude reduction of power supply, weight and volume over comparable electric power supplies. If desired a closed loop power supply can be used for continuous operation.

For the above reasons the Army has embarked on a technical program aimed at capitalizing on this group of extremely promising technical advances.

Mr. FLOOD. This also is to be considered important to the Army because it may be a substitute for moving parts in your automobile hardware as well as electronic substitutes?

General Wood. Yes.
Mr. Sikes. Here is another comment I want to make.
(Discussion off the record.)
(The information is classified and will be submitted separately.)
General Trudeau. Very good.

VAN ALLEN RADIATION BELT

Mr. Flood. At that point, will you indicate if there is any possibility, any examination, any potential of utilizing any segments or elements of the Van Allen Belt, or does your missile pass through as fast that there is no value to this?

How can the Van Allen radiation belt be utilized in any way as a periphery defense? Can you harness yourself into it?

General Trudeau. That is greater than the elevation that any ICBM will achieve, I believe.

It is out about 2,000 miles.

(The information requested is classified and is being furnished the committee separately.)

Mr. Flood. That might be in the area of satellite warfare rather than ICBM warfare?

General Trudeau. That may well be in satellites, yes.

Mr. Flood. The hazards of the Van Allen Belt are pretty obvious. Your research and development people always take hazards and turn them around. There are two sides.

It is a two-edge sword. If it is a hazard one way, it must be a hazard the other way.

How can you tie yourself into this problem of the Van Allen Belt for the purpose of which I speak, so that the distances—if it has any value, it may be in the realm of satellites, rather than the limited range of an ICBM.

General Trudeau. It could be because it is above the apogee of the incoming ICBM.

SECOND GENERATION HAWK

Mr. Sikes. Why are you not proposing to build a second generation HAWK?

General Trudeau. We are not going to build a second generation HAWK. Certain developments in the state of the art in the past 2 or 3 years lead us to believe that there may be possibilities of accomplishing something better. We are now analyzing these other possibilities to be sure we have got the best.

Mr. Mahon. All right. We thank you very much, gentlemen. We will adjourn the committee until 10 o'clock tomorrow.

TUESDAY, MARCH 15, 1960.

Mr. MAHON. We will now resume our hearing.

Mr. FLOOD. I believe you had the witness.

"ALPHABETOMANIA"

Mr. FLOOD. Yesterday we were involved in semantics, and we were discussing the humanities. There seems to be a misunderstanding on the part of the Army, and that is to be understood, as to what might be meant by the "humanities".

Let me suggest a research program to you that would be purely within the meaning of the word "humanities" as my academic friends would use it.

There is no evidence that we have rebuilt the Tower of Babel or anything like that, but there is a great deal of evidence that we have brought the language of Babel to the world, certainly to the United States, since sputnik anyhow.

Certainly you long-haired characters in research and development are about as responsible as anybody I can think of. This subcommittee has been taking a lot of punishment for the last couple of years and we have developed what you might call "alphabetomania."

That should appeal to the civilian bureaucrats, certainly. How would you like a term like "murkophrenia"? Would that appeal to you?

I refer to this murky language we are developing of "massive retaliation" and this "alphabetomania" which is developing with UNESCO on the State Department level and all of these fantastic alphabet soups that come in now as a part of this research and development and defense.

Language is the means by which you convey what is in your mind to somebody else. You defeat your whole purpose if you do not convey to us what is in your mind. You are making it increasingly difficult and I think, if that is true of this subcommittee, so much the more so is it true of your troops, even your officers, I might go so far as to say, mirabile dictu.

Imagine that. I think you are developing a barrier between the research and development mission you are trying to accomplish and the work you are doing and the people you are trying to reach. You are creating a semantic barrier which is defeating your purpose and I would hope that before this thing gets enmeshed any further in this labyrinth that some care and attention be given to the presentation of your ideas to your troops, to your officers, to Members of the Congress, and to the public.

We are developing a habit just as badly as you are. Frankly, gentlemen, this language of science, this language of research and development in the last several years could best be used to describe a nightmare which would be the result of too much beer and sauerkraut or something else. It certainly is not helping us and we have to try and help you after these hearings are over.

If you are concerned about the humanities, as my friend, Mr. Mahon, inquired, this is truly within the realm of semantics. You could have some tiny office someplace exist if for no other reason than to translate what is in your mind to the Army, to the Congress, and to the country. It would be a very important subject to deal with.

ADVANCED DEVELOPMENTS

In all of this hardware that I have noticed in the last couple of years, and in the pictures you have shown us, this hardware does not seem to be what I thought we would get in the 1961 budget in view of the pictures that were shown to us and the slides and presentations made 6 and 8 years ago, when we first started back several in Jim Gavin's day talking about the pentomic concept. We had great presentations made of silhouettes and material on mobile hardware, troop carriers, mobile guns and the mobile transport of the GOER type. We had a whole family of these things shown to us and now I see them here in your pictures and they do not seem to be as advanced as was proposed 6 and 8 years ago.

We saw then what the Russians had at that time, things that they actually had with the troops 6 years ago which looked to be just as good as you are going to buy now for the first time.

My information is that they have taken one step ahead and that they are a half a generation or maybe a full generation beyond these things which you have not yet bought.

What has happened in the last 4 or 5 years?

General TRUDEAU. I doubt that they are that far advanced.

Mr. FLOOD. You do?

General TRUDEAU. Yes, sir; I do.

Mr. FLOOD. What about their amphibious stuff, river-crossing and lake-crossing stuff? You showed us yesterday one of the amphibious GOER's. You think they have had an amphibious operation of this kind for about 4 years?

General TRUDEAU. Probably.

Mr. FLOOD. If they have had one for 4 years, do you not think the ones they are going to buy next year are much better than the one you have not got yet?

General TRUDEAU. Perhaps.

Mr. FLOOD. Perhaps?

General TRUDEAU. Perhaps. We are not doing badly. We have armored personnel carriers but we do not have enough of them. We would like to buy more.

ARMORED PERSONNEL CARRIERS

Mr. FLOOD. Let us talk about that and that brings this to my mind. Two years ago I spent two days and two nights in the field with these new German Panzer grenadier units in Germany. Good looking troops. They had an Isota-Francini Italian troop carrier and they were going to buy them. Several years ago the troop carrier that the research and development crowd showed us had automatic covers, protection for the troops. It was a mobile troop carrier but yet on the dash a control lever like a convertible with a steel cover over it, it was cover against blast. It was cover against fire. It was cover against radiation.

General TRUDEAU. No.

Mr. FLOOD. To a degree?

General TRUDEAU. It is not yet possible.

Mr. FLOOD. All right. It was cover against certain light arms. It was mobile and it was the German Panzer grenadier concept before they started to do it. They were doing it 2 years ago; but I am talking about 5 and 6 years ago. I saw these, just exactly what I thought would be right, and the Germans have that kind of a bird.

You do not have anything like that? You do not even show me pictures of anything like that anymore, and why not?

General TRUDEAU. We have a good armored personnel carrier that will do everything that is necessary. We are talking about simplicity and reliability and not all of the things we dream about. These are the hard facts of life, what American industry can produce and what we can afford to buy.

Mr. FLOOD. We are not concerned about what we can afford to buy. I happen to be a member of this committee and the Congress who wants you to get what I think you should have.

General TRUDEAU. We appreciate that, believe me.

Mr. FLOOD. I am not a balancer, as far as you are concerned, especially the Army, so that answer is all right for too many Members of Congress, but it leaves me cold. Is that piece of hardware that I am talking about too fancy? Is it too tricky? Is it impractical, or what?

I would like to see a platoon of Panzer grenadiers fight from the moving vehicle and be shielded, if necessary, with a convertible cover as they are moving and fighting. These are advanced echelons, Panzer grenadiers. It is a new concept really, but there is nothing new about Panzer grenadiers or this concept of fanning out mobile covered protected infantry and backing up your chopper cavalry at certain points in this new wide area that an Army division must cover, and it strikes me as being very essential.

Is that desirable and wonderful, but we just cannot do it, or what?

General TRUDEAU. I think we are approaching that concept with the new armored personnel carriers, the new tanks, and the aircraft that we are seeking.

Mr. FLOOD. But this personnel carrier does not have a convertible steel cover of any kind over the top of the troops, if you are getting into a bad area? It is open, like it has always been?

General TRUDEAU. No, sir; it has a closed top.

As we go into further production, there probably will be several variations; some types probably will be open at the top; some will carry DAVY CROCKETTS and maybe mortars, it is possible that one version may mount a light 105 mm. rifle. It is quite flexible, Mr. Flood.

Mr. FLOOD. All right. I do not want to insist, but I would not buy a personnel carrier for mobile infantry fighting as they move. I do not want men, as in World War I brought up in trucks, have them jump off and walk 5 miles and fight.

I mean fast, mobile, not light, infantry troops, but heavy infantry troops who can fight from the vehicle and move with it as they are moving.

I am very much impressed by what the Germans are thinking along this line, and it is what our people were thinking 6, 7, and 8 years ago, when I first saw the petomic concept presented, the new wide front for a division in depth.

I would not like to think that because of a lack of ability in American production, lack of dollars as always, that you have to buy something half as good as you should have in the years ahead.

Are you going to be held down by money? Are you going to be held down by lack of vision, or do you think this Panzer thing we have got is what you want?

General TRUDEAU. I think we are making generally good progress. We could use more money in research and development, that is true, but all things considered, these are fair allocations.

The next important thing, of course, is to have the appropriations for procurement. That is the other part of the picture which you have, but that is not a part of R. & D. We have dozens of items that are ready for production but the Army has, as yet, been unable to procure, or to procure in any numbers.

Mr. FLOOD. I just cannot imagine, as far as the Army is concerned, anything more important than the vehicle I first saw while I was sitting on an Army panel for this subcommittee 8 years ago, upstairs on the fourth floor.

Why that is not in the field with troops today and moving on maneuvers in West Germany, I do not know.

General TRUDEAU. The armored personnel carrier is in production. Incidentally, ours has a closed top. We know that some of the Russian carriers have open tops. We are not too far behind on any of this.

(The following additional information was later provided for the record:)

A review of past testimony to this committee reveals that the vehicle concept referred to by General Gavin several years ago for a multipurpose armored personnel carrier and discussed by Mr. Flood, was realized in the development, standardization, and procurement of the M–113 Armored Personnel Carrier. The M–113 is characterized by light weight (approximately one-half that of its predecessor the M–59), has a lower silhouette, is air transportable, is capable of delivery by parachute, is amphibious, and has increased operating range. The M–113 incorporates an opening top hatch for infantrymen to deliver small arms fire, a driver's vision cupola and vehicle commander's cupola mounting a machinegun. In other words, the Army has developed and standardized a vehicle that meets the operational requirements referred to by General Gavin.

Mr. FLOOD. Not too far behind on what?

SOVIET WEAPONS

I heard it said here, year after year for the last 5 or 6 years, that the Russian Army hardware is superior to ours; that they have refurbished their Army at least once and a half, and maybe twice, from top to bottom, since World War II; that we still have about 60 percent of Korean and World War II hardware around. If it is true that we are still fighting or still equipping our Army with 60 percent Korean and World War II hardware, and if it is true that the Russians have done over their Army twice, giving their satellite nations the obsolete ones, that would make their satellites a little bit ahead of us and would make the Russian hardware certainly, at least, once over all more advanced than ours.

I have never heard that premise questioned. The British tell me that is true. The French tell me it is true. The West Germans tell me it is true and all the Americans up until this morning tell me it is true. What about it?

General TRUDEAU. They have refurbished their army and they have good, rugged, simple equipment. This is true. We have not been able to refurbish ours completely. The losses in military equipment during the Korean war, for instance, were very great, and while we have some weapons that were used in World War II, this does not necessarily mean that they are poor weapons. They have good killing power.

The pistol we use is still the model of 1911, but there is nothing better on the market today.

CALIBER .45 PISTOL

Mr. FLOOD. You do not mean the .45?

General TRUDEAU. I do.

Mr. FLOOD. That howitzer?

General TRUDEAU. I do.

Mr. FLOOD. Do you have wheels to pull it behind you on the road?

General TRUDEAU. No. A good solid hip will take care of that.

Mr. FLOOD. Nobody in any army in the world agrees with you on that, but if that is your position, I think you are wrong. I think the idea of sending a man out with that is wrong. All you need in that is an "A" head and you have a good field weapon.

That is practically an atomic weapon if you can put an A-head in it.

You know more about this than I do, but I am telling you what I think and what a lot of other people tell me. It is nonsense to have a cannon like this on your hip.

In talking yesterday to Mr. Sikes about this flechette rifle with perhaps pneumatic propulsion, that is the kind of thing which I think is great. Why, if you are going to do ——— with perhaps pneumatic propulsion, do you want this .45 automatic still around?

General TRUDEAU. What I am trying to point out is that because something has been in the inventory for some time is no reason to condemn it. In war, about as fast as you produce anything, it is obsolescent, but nothing is obsolete. The man equipped with a trench knife is well armed against the fellow who is not.

I want to clear up what I meant when I said we are not far behind. The inflection with which I made that statement will not be recorded in the record.

I do not believe we are behind. I think we are behind only as far as the equipment with troops is concerned. In the general quality of our weapons systems and equipment I think we are doing very well indeed.

The next thing is to get them into the hands of troops. There are gaps, I admit that.

Mr. FLOOD. That is your Army research and development, and if I do not talk to you about this, it is unlikely that this record will show it. I am concerned about it. I have been told and I have been led to believe, and I am seriously concerned, that the Army of the United States is equipped up to 60 percent with obsolescent hardware in most categories.

Secondly, not enough of that and certainly there are material and substantial and important gaps vis-a-vis Russian ground troops and

advanced modern hardware since World War II. I want to make the record clear that that is what I think and that is my information.

SOVIET TROOP REDUCTIONS

While I am on that point, I want to refer to the first page of your statement. On page 1, the second paragraph, you say that even if such reductions in their military forces actually are accomplished in the future, there is little question that numerically the Sino-Soviet bloc forces will continue to overbalance those of the United States and its allies.

That just is not so. That is a misstatement of fact. Do you want to correct that?

General TRUDEAU. No, sir.

Mr. FLOOD. Are you telling me that it is your opinion and conclusion—that is my information and I checked this last night—that the total of the Western allied forces actually numerically outnumber the Sino-Soviet bloc forces?

General TRUDEAU. I am not impressed with it as an argument.

Mr. FLOOD. I am not impressed by your argument.

Are we going to leave it like that?

General TRUDEAU. As far as I am concerned, it can remain there, sir.

Mr. FLOOD. That is where you want it to hang, and if so, we will let it hang there. However, I want you to know that I challenge that.

MOHAWK AND CARIBOU

By the way, what is the length of runway necessary for the Mohawk and Caribou takeoff in feet, about? Not maximum, but what is it approximately?

General TRUDEAU. About 500 to 700 feet. It is 900 feet over a 50-foot barrier.

General BRITTON. Your runway, allowing for safety, is in the 800- to 1,000-foot category. In other words, you cannot have the exact amount of runway, but we are talking in terms of 800 to 1,000 feet of strip.

Mr. FLOOD. That is for both of them?

General BRITTON. Yes, sir.

Mr. FLOOD. Is that as good as it should be? That is longer than what we were talking about several years ago when we first started talking about this kind of aircraft for this mission. Eight hundred feet is longer than anything I was thinking about. I could be wrong about that, but I envisioned for the short takeoff, the big jet transport taking you into the fighting area and then either with choppers or this Caribou or Mohawk moving both your advanced fighting echelons and your fighting hardware for support up into the fighting area.

General TRUDEAU. Right.

Mr. FLOOD. If an 800-foot runway is too much runway to come into a fighting area, I do not know, but I have come down in DC–3's in South American grass fields. However, if you people know what you want, I might have been wrong in my thinking several years ago. I thought of these troops and hardware coming down into the fighting zones with a pretty rugged tough craft. I guess they are that.

General TRUDEAU. They are rugged, all right. Actually the Caribou loaded can take off and land in less than 500 feet if you want to pour it on.

We have prescribed a certain standard to be met but it is being exceeded. I could tell you that very interestingly we have landed the Mohawk, which is a much faster plane, in 200 feet.

Mr. FLOOD. During World War II you never saw a DC–3 take off any place in the world where it was not overloaded by at least 20 percent with everything. I know all about that. If we keep that thing down so that the Army flyboys do not think they are going to have hardtop runways with lights, towers, for this kind of operation, fine.

General TRUDEAU. This is basic in our design concepts.

DAVY CROCKETT

Mr. FLOOD. What do you want with a light and heavy Davy Crockett? Why both of them?

General TRUDEAU. It is the question of range. We want one that can easily be moved up—man-portable—to be emplaced in forward areas at short direct ranges, and then the heavier version with a greater range capability. This is just the first generation and there may be many changes, but we had to get into production, and we have a good weapon to start with.

SOVIET PHOTOGRAPHS OF THE MOON

Mr. FLOOD. Are you the proper people to tell me whether or not you think the Russians were telling the truth when they took pictures on the black side of the moon? Is that your shop or Dr. York's shop?

General TRUDEAU. Quite properly ours.

Would you like to comment on that, General Dick?

Mr. FLOOD. We have been kicking that around for a couple of days. What do you think?

General DICK. I do not think there is any good reason to doubt what they say. I think they have the capability.

SOVIET CHEMICAL CAPABILITIES

Mr. FLOOD. I was amazed by this reference of yours—I forget who made it, but I made a note as it was being read—that one-sixth of the Soviet ground potential is chemical, as far as weapons with their forces in Europe are concerned.

General TRUDEAU. I made that statement.

Mr. FLOOD. What does it mean?

General TRUDEAU. What we mean by that is that of the munitions that are available to the Russian forces for use in the West, let us say in Poland or in East Germany, ——— indicates that they are equipped to about one-sixth of their total tonnage.

Mr. FLOOD. Is that right?

General TRUDEAU. Chemical weapons.

Mr. FLOOD. There are dozens of thousands of Soviet troops, plus their satellites, on that western border?

General TRUDEAU. That is right.

Mr. FLOOD. Division after division, after division. Thousands of them.

You are telling us ——— that one-sixth of their hardware and munition inventory is chemical warfare?

General TRUDEAU. That is our best belief; yes, sir.

Mr. FLOOD. Well, it is going to be a very unpleasant war.

General TRUDEAU. What would be more natural if there was an offset or standoff with respect to nuclear weapons than for the Russians, if they decide to move West, to attempt to seize an area or industrial complex of the Ruhr without destroying the works of man, or even the people who are operating it, unless they are military people they have to put out of the way. This is a real threat.

Mr. FLOOD. I am very much impressed by this because I believe this: If somebody shoots a cap pistol in Western Europe, that is it. That is world war III. There is not going to be any limited war in Western Europe no place. The first bang, the lid goes off.

If there is any movement there, they do not want to destroy Western Europe but take it over.

You are suggesting, from what you told us, that the way to do it is by these disabling chemical attacks rather than kill and destroy?

General TRUDEAU. Right.

Mr. FLOOD. I think that is persuasive and effective and certainly not generally known.

General TRUDEAU. No, I am afraid not.

Mr. FLOOD. We are so immersed in ICBM, IRBM, SAC, nuclear warfare, that we are losing track of this very, very practical, disabling, nondestructive, chemical attack.

General TRUDEAU. (Off the record.)

NIKE-ZEUS

Mr. FLOOD. For a minute, I want to be the devil's advocate on NIKE-ZEUS. Everybody that has come in here on NIKE-ZEUS—Navy, Air, and everybody—everybody says it is no good. They have no confidence in it. They think you are weak-minded in the Army and they do not know what the Army wants with it. They do not say it quite this bluntly, but from the expressions on their faces, and the smiles and smirks all over the room, they think that this is an outrageous performance by the Army.

Mr. MAHON. Will the gentleman yield at that point?

Mr. FLOOD. Yes.

Mr. MAHON. The words of one of the writers who appeared in one of my school books comes to mind with reference to this matter: "Damn with faint praise, accent with civil leer, and without sneering, cause the rest to sneer."

Mr. FLOOD. I could not have said that better.

How could I say more than that? That I will embrace although it is a little moth-eaten.

I hope the NIKE-ZEUS is much more advanced than that, but anyhow I want you to know that nobody has a good word to say about it, absolutely nobody.

We have had them here for 3 months and they insist that you ———.

They think it is a waste of money, time, and I cannot understand why they permit you to go on at all from the top down. This is from Gates right down to the elevator operator.

I have heard they are all out of step but Jim. Why in the world do all of these people totally agree that you do not know what you are talking about? Are they all wrong?

General TRUDEAU. I am perfectly willing to be Jim in this case. I would like to say that while I had faith in our ability to produce a usable NIKE-ZEUS system last year I am enthusiastic about it this year because of the advances that have been made in the state of the art.

Mr. FLOOD. I know, but it is a limited point defense. It is not hardened. It is soft. It is above ground. He will murder you.

We are putting everything we have underground and you are as naked as the day you were born with the ZEUS system above ground. You are nowhere near.

(Off the record.)

General TRUDEAU. ZEUS is to stop the warhead, not absorb the blast when it hits the ground. We expect to be on top.

Mr. FLOOD. I know that, but the enemy knows you are soft. We are making the MINUTEMAN mobile. We are making ATLAS in the second generation and TITAN second generation hard. Here you are coming along after these things are operational and you are naked and soft above ground. You have only a limited point defense anyhow?

General TRUDEAU. I cannot knock down enemy missiles if I am below ground. I have to be on top to hit them.

Mr. FLOOD. I understand. You are a counter-attacker. You are a counter-puncher under our national policy and you must counter-punch.

General TRUDEAU. I am no counter-puncher. I am going to stop them from coming in.

Mr. FLOOD. What about this limited point defense? What good is point defense for 30 percent of the Nation? Good for the 30 percent? You have a limited point defense and your HERCULES and AJAX have lace curtains, that is about all.

General TRUDEAU. Do you want anything or nothing? That is what you have to resolve for yourself. Is the coach on the team going to take the goalkeeper, whether it is lacrosse or hockey and put him in the middle of the field because somebody might kick a goal, or do you want the goal defended?

Mr. FLOOD. Are you going to bank upon the psychological assistance of the American people that we have to have something whether it is good, bad, or indifferent? We have to have something?

I will be frank with you. The only thing I heard, and this is shocking, the only substitute I heard from Dr. York, and up and down, for NIKE-ZEUS, was to build shelters for the public. That is the only answer.

General TRUDEAU. This is completely wrong. You need a passive defense in this country and you need an active defense. NIKE-ZEUS is the only thing that has got a chance of doing it before 1970. You have had many air defense systems built before. While it was not

forecast what their cost would be, the net cost was greater than it is going to cost you to produce NIKE-ZEUS. Some of these air defense systems are obsolescent now, if not obsolete.

Mr. FLOOD. Why would you show me a picture here yesterday and expected me to believe you could ———? What decade?

General TRUDEAU. ———.

Mr. MAHON. You can elaborate on that for the record.

Mr. FLOOD. That is all.

(The information is classified and is being provided the committee separately.)

Mr. MAHON. Mr. Ford?

Mr. FORD. General Trudeau, if I may I would like to pursue the NIKE-ZEUS problem. The thing that bothers me, and I know it has been a problem both from your point of view as the proponent, and the point of view of those do not agree, is the so-called ——— issue. Originally we did not hear much about that as a problem in this program, or at least I did not hear it discussed with any degree of concern; but in recent months that seems to have been the principal issue that has been raised concerning the successful operational capability of the NIKE-ZEUS system.

What is the Army's side of that particular problem?

General TRUDEAU. Is this classified?

Mr. FORD. You can put it on the record but it will be only on the committee record.

General TRAUB. We do not have to worry at all about testifying. It will be expunged from the published record, if classified.

General TRUDEAU. I would like to address myself to this ——— problem. There is a distinct difference of opinion in this field.

(Discussion off the record.)

General TRUDEAU. The OSD director of research and engineering has recently given us program approval of $25 million.

Mr. FORD. When was that done?

General TRUDEAU. It is just in the process.

General TRAUB. Last night.

General TRUDEAU. I would also like to mention the purpose because I think this will interest you. Each of the small gadgets that you see in this little square are resistors, transistors, capacitors in the NIKE-ZEUS system. Each will take the place of a radio tube as we now know it. You can see that they are extremely small and require less power and have practically no weight. Actually, the electrical part of it is just this flake of pure metal you see in there. What has happened in the past is that these have cost us in the neighborhood of $20 apiece to produce by hand with people working under microscopes because of the minuteness. Those parts are twenty one-thousanths of an inch square and six one-thousandths of an inch thick. That is the electrical part. The rest of it is just housing.

What we want to do is develop equipment—and we are sure this can be done and there is a little work done on it now—to get an automated line that will get these down to where they cost about $5 apiece and also turn them out so that 80 or 90 percent of them will be perfect. In other words, will be reliable and rugged, and we will not have losses such as we have had by doing it by hand.

I thought you would like to see how that money is going to be spent. This is a tremendous advance, no matter what happens, hundreds of thousands of these would be used in the ZEUS system. No matter what happens to ZEUS, this will represent a tremendous contribution to American industry because this will be used in space vehicles and in many other electronic applications.

Mr. FLOOD. One of your great achievements in this whole fight about which we do not get enough credit is this genius for miniaturization of ours; is that correct?

General TRUDEAU. That is correct.

Mr. FLOOD. Against this other guy?

General TRUDEAU. This is one point where we are not behind.

Mr. FLOOD. In fact, we are ahead?

General TRUDEAU. We are in the lead on this.

Mr. FORD. If you carry out this program that is contained in the budget for fiscal 1961, which envisages completion of tests at White Sands by ——— when do we get under that schedule our first operational capability of a NIKE-ZEUS, assuming that thereafter you have procurement money?

General DICK. (Off the record.)

Mr. FORD. ——— from the end of fiscal year 1961?

General DICK. From whatever day you say we are going to do it and, "Here is the money."

Mr. FORD. How big an operational capability are you considering?

General DICK. This is not our particular problem. The latest stated requirement by the commander of the North American Air Defense would call for ———.

Mr. FORD. That would be completed at the end of ——— from the time you got your go-ahead?

General DICK. Right.

Mr. FORD. That is the program?

General DICK. No, that would not be completed at the end of ———. You would get your first increment of that ——— from the date you said you wanted it.

Mr. FORD. That ——— battery program is the one that costs how much?

General DICK. (Off the record.)

Mr. FORD. You have to crank in military construction costs in addition to that which takes it up to around ———?

General LINCOLN. Plus research and development, plus some O. & M. which would bring it up to around ——— grand total, including the money already spent in research and development.

R.D.T. & E. APPROPRIATION

Mr. FORD. In the budget document which we have before us here, it shows for Army research and development $1041.7 billion. In the green sheets, it is $200,000 less.

How do you reconcile that?

General WOOD. I believe the difference is in NOA and direct obligations, but I would ask Mr. Woodside, my budget man, if that is not correct?

Mr. WOODSIDE. Yes, sir. I believe that is so.

NOA request on the third page of these green sheets is shown as $1041.7 and direct obligations on the first page is $1041.5, as I read it, Mr. Ford.

Mr. FORD. The higher figure is new obligational authority and the lower figure is total direct obligations?

General WOOD. Yes, sir.

Mr. FORD. It is my recollection that for fiscal 1960 the Congress made available to the Army for research and development the budget figure; is that correct?

General WOOD. Not quite. You may recall that we came up for $1,046 million, roughly.

You appropriated $1,035 million, roughly. I do not remember the exact figure, but the reason for that change of $10,800,000 (I remember that specifically,) had to do with the Air Defense master plan which was produced by the Secretary of Defense while the budget process was going on.

NIKE-HERCULES FUNDING

In doing that, the Defense Department recommended that our funding for NIKE-HERCULES specifically be cut by that amount. It was on the order of a cut from $20 to $10 million, as I recall, because of their direction of the overall master plan which curtailed the number of HERCULES batteries to be deployed and so forth.

Actually, that $10.8 million was going to be spent, if I recall, for two developments on the HERCULES system which we had decided not to pursue. One was the frangible booster in lieu of the metal booster and the other was the ———.

We decided not to do that, so the Office of the Secretary of Defense, in coming up with this master plan and in looking for money to fund it, curtailed the research and development appropriations of the Army by $10.8 million.

Mr. FORD. The net result was that the Congress gave to Army research and development what the budget was with this revision?

General WOOD. That is correct; yes, sir.

Mr. FORD. This revision in the overall Air Defense master plan took into account cuts in NIKE-HERCULES, BOMARC, and several other programs?

General WOOD. That is correct; almost entirely in the procurement area, but the R. & D. cut was a fallout from that.

Mr. FORD. If you look at the sheets in the budget document, you will see that starting with fiscal year 1960 our research and development obligational authority would appear to be about twice what it was in prior years. We know that that change has come about because of the reshuffling of responsibilities for research and development.

General WOOD. You recall that 1960 is the first year for the research, development, test and evaluation appropriation. Previously, there was only research and development and it was supported from the procurement appropriation.

Mr. FORD. Will this change, how we handle research and development starting with 1960, lead some people to believe that maybe we were doubling the amount of research and development?

General TRUDEAU. Actually, it has cost us something and I want to tell you why: Having fixed appropriations now covering research, development, test and evaluation, and no longer being able to go to the Deputy Chief of Staff of Logistics for PEMA support, we have a fixed sum. In previous years, we have been able to get a little more from him in support of some of our projects than had been programed under the PEMA appropriation.

Really, instead of adding to the overall funds available, this has detracted a little bit.

The figures could probably be given here.

Mr. FORD. That was the question I was about to ask. When you look at the programs, are we doing about the same level of programing for research and development now that we did in years prior to fiscal year 1960?

General WOOD. I would say about the same. What General Trudeau is saying is that we have lost a little flexibility. In the procurement area, changes in the cost of materials, labor, and so forth, may exceed the estimate, and, therefore, result in what is called overruns in the way of funding. We have lost that flexibility a little bit, but so far as the overall magnitude of the program is concerned I think it is correct to say it is essentially on the same level of, roughly, a billion dollars.

Mr. FORD. What is your obligation picture for fiscal 1960 at the last reporting date?

General WOOD. Mr. Woodside?

Mr. WOODSIDE. Actual obligations as of the end of January were $669 million approximately.

Mr. FORD. Against what total?

Mr. WOODSIDE. Against the total of $1,101 million.

General TRUDEAU. I would like to add this with respect to NIKE-ZEUS.

The Army's position is that there is a valid strategic requirement for NIKE-ZEUS in the defense of the continental United States for seven reasons.

I would like to give you the thought here that while there is a great contest going on, as to how many missiles we should produce and how many it would take the Soviets to have a preponderance, they could gain the same preponderance of power if they ever came up with the equivalent of NIKE-ZEUS where they felt sure only a fraction of American missiles could get through to their homeland. If we are naked at that time it could create a very difficult position for our own country to decide.

Mr. MAHON. You can elaborate on that for the record.

General TRUDEAU. That is all I have to say.

Mr. FLOOD. Add a very important one reason: There is not any more?

General TRUDEAU. That is it; we have had it, if that day comes.

R.D.T. & E. OBLIGATIONS

Mr. FORD. How much do you expect to have unobligated at the end of the fiscal year?

Mr. WOODSIDE. The unobligated balance at the end of 1960 is anticipated to be $29.9 million. The unobligated balance at the end of fiscal year 1961 is estimated at $30.1 million.

Mr. FORD. Are these about the normal carryovers for unobligated funds in this account?

Mr. WOODSIDE. Yes, sir. It does run about that amount normally. However, if you look at the unobligated balance at the end of 1959, it shows $57 million approximately, and the reason, as was explained yesterday by General Wood, was approximately a $20 million emergency fund transfer on June 30 of that year.

Mr. FORD. This $25 million which was released for the NIKE-ZEUS long leadtime procurement, will that have any adverse impact on your unobligated balances?

General TRAUB. We are not sure, Mr. Ford, just from what source that money is going to be provided. Dr. York's memorandum to the Army, addressed just last night, indicated that the Assistant Secretary of Defense (Comptroller) would provide the necessary funds.

We are not certain just where the money is coming from. It may come from the military personnel appropriation unobligated balance, which would normally expire for obligation on June 30. It may come from the emergency fund of the Office, Secretary of Defense; or another possibility is that it may come from the $175 million that is earmarked for transferring in 1961.

Mr. FORD. In the PEMA account?

General TRAUB. Yes.

Mr. FORD. If you get that answer before the hearings are printed, I think it would be helpful to have the facts in the record.

General TRAUB. We will supply it for the record if it is available at the time the transcript comes down.

(The information will be furnished to the committee as soon at the source is determined.)

General WOOD. I think it is a better than even chance that it will be obligated before the end of the fiscal year.

Mr. FORD. There is no doubt you can obligate it under your program?

General WOOD. Yes, sir.

FUNDING IMPACT ON TRANSFER OF VON BRAUN TEAM

Mr. FORD. Where do we see the impact of the transfer of Dr. von Braun and his people?

General WOOD. You do not see that at all because that comes out of the industrial funding area. Consequently the personnel are not carried in the R.D.T. & E. budget.

General TRAUB. That is correct. It would have no impact upon this appropriation at all.

Mr. FORD. Is that scheduled to transpire at a particular time?

General TRAUB. July 1 of this year.

Mr. FORD. All of ABMA is under the industrial funding at the present time?

General TRAUB. Yes, sir.

General DICK. There is one other factor to clarify this. All the space work done by Dr. von Braun's team was financed by ARPA or NASA. All of the missile work done by that team must, of course, be carried on after they leave, either by contract to them through NASA or by placing the work somewhere else. There is

no less Army work being done by the Army. A lot of their work was done for the other agencies outside of the Army.

Mr. FORD. There were no fund transfers in fiscal 1960 from the Army R. & D. account to NASA to handle those responsibilities?

General TRUDEAU. No, sir.

General TRAUB. None that I know of, sir.

General WOOD. No, sir.

Mr. FORD. Please supply for the record any transfer of funds that were involved in the transfer of Dr. von Braun and his team to NASA or any other related similar transfer.

General TRAUB. Yes, sir.

(The information requested follows:)

TRANSFER OF FUNDS TO NASA

A total of $4,078,250 fiscal year 1959 funds was transferred from the Army R. & D. appropriation to the National Aeronautics and Space Administration in connection with the transfer of the Jet Propulsion Laboratory to NASA.

V/STOL AIRCRAFT DEVELOPMENT

Mr. FORD. Over the years we have heard a great deal about some of your research and development work for the development of a high-speed, highly mobile, flexible, V/STOL assault transport aircraft. I did not see anything about that in the presentation this year.

General WOOD. This is one of the three areas the Army Aircraft Requirements Review Board, which I described yesterday—I think you were here at the time, Mr. Ford—has just finished looking at. It is an area which has two prongs to it, really. The first is the probable requirement in the latter part of this decade to replace the Chinook and the Caribou, only now beginning to come out and not yet in the hands of troops, which together form a capability for the Army to move personnel and cargo within the Army area.

The second is the need to consider whether or not the Army needs a vehicle of a larger size, with V/STOL characteristics, to move cargo and personnel—from wherever the Air Force strategic lift may deliver them at a big airbase—forward into the Army area.

In the first category, the Army Aircraft Requirements Review Board decided it was not timely to initiate development with fiscal year 1961 funding until we learned more about what the Chinook and the Caribou could do. The Board recommended that R. & D. should conduct studies in 1961, based on what we had learned from our test beds, and on what industry could propose. These studies would permit initiation of development in 1962 of the best type aircraft for the job.

In the second area the Board proposed to the Chief of Staff that we not develop an aircraft immediately because it still looked to us as an Air Force tactical airlift mission. Until and unless the Air Force felt it did not have the capability to perform the mission, the Army should not use its funds to duplicate that effort.

What I am saying is that with fiscal 1961 funds we will not initiate the development of a transport assault aircraft, but we will perform studies and investigations on the results of which would lead us in 1962 to start a program if it seemed indicated at that time.

Mr. FORD. It is my recollection that the Navy has been doing some research and development in this area.

General WOOD. Yes, sir.

Mr. FORD. It is also my recollection that the Army was participating in a joint venture. Is that true?

General WOOD. Not quite. The Army is familiar with what the Navy and the Marines have been doing. The Marines, as I understand it, feel they need to replace the helicopter transport they have, which I believe they call the HR2S (H–37 in Army phraseology), built by Sikorsky. The Marines do not have coming along, as the Army does, the CHINOOK and the CARIBOU, nor are the Marines too interested in either of those aircraft. The Marines, as you know, want an aircraft which can be carried on aircraft carriers and, therefore, requires folding rotor blades if it is a helicopter type, as well as of a size to fit on aircraft carrier elevators.

I am not certain of the exact status of the Marine-Navy thinking so far as this current fiscal year is concerned. However, I believe they did plan to initiate an aircraft in that area.

OSD, which is evaluating all three departmental plans, I learned yesterday, is receptive to another recommendation of the Army Board; specifically that there be a triservice development in this area over the next year, if at all possible, and if all requirements could be satisfied that way by a single type of aircraft.

Mr. FORD. What has happened to these programs of the past where you had, as I recall, some prototypes being built of vertiplanes, as they call them?

General WOOD. We had test beds which range from the tilt wing variety, which Vertol made, the Doak ducted fan where the fans are on the end of the wing tips and turn, the Ryan flap arrangement for deflected slipstream, and the Piasecki flying jeep.

We completed "Research and development, Army," funding of those projects with fiscal 1960 money and are evaluating the results now along with a certain amount of NASA wind tunnel work and final contractor testing. These were never designed to be specific aircraft for the future, but were test beds to determine utilization of principles. As a matter of fact, we want the time to evaluate what we learned from those test beds before we decide what approach is best for the future so far as a transport aircraft is concerned.

MAPPING AND GEODESY

Mr. FORD. In this shopping list for research and development for the Army there is an item called mapping and geodesy. What do you do in research and development on mapping and geodesy?

General TRUDEAU. What grouping is that under?

Mr. FORD. Other equipment, page 3. The amount in fiscal 1960 is $7,360,000. The amount proposed in fiscal 1961 is $6,333,000. We fund for the Army Mapping Service a program every year that runs in the magnitude of around $40 million.

General WOOD. It is an engineer project falling under General Britton. He can give you more details than I.

General BRITTON. The primary thing in this area is we are working on the methods of mapping, triangulation, and getting the necessary map data as we project forward into enemy-held territory. In

many parts of the world we do not have adequate maps, particularly for target work and fire control.

In order to obtain the necessary controls—that is, triangulation—we must have a system whereby we can project forward. This area of mapping and geodesy is the primary area in which we are operating with these funds.

Mr. FORD. I do not see why you should have money here and they should have money there, speaking of research and development in one case and Army Mapping Service in another.

General BRITTON. Sir, the Mapping Service is in the work of the actual mapping, in the production of maps and the production of map supply, printing, and final preparation. Research and development work is in the forward area, the field Army work under combat conditions and is the type of systems, map compilation machinery and data we need to finally put this into a usable form. They are different functions.

Mr. FORD. It may be, but I do not understand why this is in research and development. It seems to me that maps, as you have described them, would be a production item rather than a research item.

General TRUDEAU. Geodesy gets into the field of space and there is a payload, a satellite to be prepared and developed for geodetic work for mapping and geodesy, geodetic efforts in space, and this requires a very extensive study of new techniques and new equipment.

General BRITTON. For example, we would use radar in getting certain data, airborne radar. We have to correlate that with our different positions of aircraft. This requires very precise navigation or knowledge of the aircraft's position from the ground under the forward area combat type situation. We are not talking about the equipment we print the maps with. We are talking about getting this necessary control data in an area not held by ourselves, which we must do under combat conditions, which is distinct from the other. There has been a period, which is still going on, in the worldwide mapping service which is actually gathering engineering data and producing the maps, which is the function, of course, of the Map Service. We do not by this produce at this time under research and development any maps.

General WOOD. This is also related somewhat to research on electronic machines, which would expedite the compilation of data and make it available more quickly so far as the commanders in the field are concerned.

For example, the Engineers are working on a device, which can take the tremendous amount of photographic material usable in this compilation of maps and in geodesy and pass it through a machine so that you have a reference file, because such photographs have distinctive signatures of their own so that you can get out of this machine what you want for a particular area at any time you want it and thereby facilitate and expedite your compilation of whatever maps are required.

I want to make a distinction, which I am sure you recognize, between the actual operation of the Army Map Service, not funded by research and development, and work which goes on essentially in the Engineer Research and Development Laboratory.

(The following additional information was provided later for the record:)

MAPPING AND GEODESY

In addition to the work already described other projects included in this field are:

1. *Map reproduction.*—Development of an automatic point plotting instrument, electrostatic printing machine and target map coordinate locator to increase field map reproduction and increase mobility.

2. *Combat mapping and geodetic systems.*—Conduct of engineering design and tests on interim equipment using primarily photographic and aerial triangulation for mapping in enemy territory. Conduct of engineering design and tests on equipment to provide an automatic map compilation system. Conduct of feasibility studies and engineering tests on equipment using radar for long range, all-weather mapping in enemy territory. This is in direct support of the program to provide target location in enemy territory for artillery and guided missiles.

3. *Map compilation.*—Conduct of tests on a photo imagery interpreter's kit, precision projection, a device to correct for photographic tilt of aerial photographs, and a device to rectify variations in altitude. This equipment will reduce the time required to compile topographic maps.

4. *Surveying and geodesy.*—Conduct of tests on equipment, techniques, and systems to provide increased speed and accuracy for mapping, missiles, and artillery systems. This is in direct support of the program to provide artillery and launcher location of friendly units.

5. *Support for tactical mapping.*—Development of techniques and equipment for manner aircraft or drones to provide accurate three-dimensional data of ground locations in enemy territory for preparation of Corps of Engineers maps in a theater of operations under all types of weather conditions with minimum geodetic control.

Funding for these projects in fiscal year 1960 and fiscal year 1961 is:

Project	Fiscal year 1960	Fiscal year 1961
1	$389,000	$281,000
2	2,377,000	1,851,000
3	224,000	55,000
4	2,236,000	2,546,000
5	2,120,000	1,600,000
Total	7,346,000	6,333,000

Mr. SHEPPARD. Will the gentleman yield?

Mr. FORD. Yes.

INTERSERVICE ASPECTS OF ARMY RESEARCH

Mr. SHEPPARD. I will pick this section under "Military sciences" of the shopping list before us and I ask you this question. Are any of the funds requested here for fiscal 1961, allocated to other services that are functioning in this field? Are you contributing to other services or is this direct expenditure upon the part of the Army exclusively? Is my question clear?

General WOOD. Yes, sir; I understand your question. Let me answer it this way. This general area is an area in which Dr. York's office has a considerable number of committees and staff offices within his office which work on different pieces of it. For example, a Materials Committee, a Propellants Committee, a Sciences Committee in different areas, atmospheric, earth, food, et cetera.

many parts of the world we do not have adequate maps, particularly for target work and fire control.

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General WOOD. Yes, sir; I understand your question. Let me answer it this way. This general area is an area in which Dr. York's office has a considerable number of committees and staff offices within his office which work on different pieces of it. For example, a Materials Committee, a Propellants Committee, a Sciences Committee in different areas, atmospheric, earth, food, et cetera.

The other serviecs are exerting effort in some of these areas, but I would say that it is not duplicative and that what each of us does is of some value to the other. It varies in areas and what I have made is a general statement.

Mr. SHEPPARD. Your answer to my question is that the funds requested here are to be expended strictly by the Army and you are not contributing to some other service in this same field; is that correct?

General WOOD. The work here is to satisfy Army needs, but any scientific area you get into, you satisfy others' needs also as a fallout.

Mr. SHEPPARD. I grant you that. However, my question was directed to one specific aspect. I do not want to belabor it. We find in many instances, certainly, that you are assigned certain missions in the field of science. All right. Over here, at the designation of Dr. York or someone else, is a specific, concentrated effort to which you contribute your funds. Does that prevail in this category to which I refer? What I am trying to determine is: Are these funds to be directly expended by the Army exclusively or are they proportionately contributed to other agencies designated by Dr. York?

General WOOD. This is all spent and funded by the Army in this particular field.

Mr. SIKES. Will the gentleman yield?

Mr. FORD. Yes.

ELECTRONIC ENVIRONMENTAL TEST FACILITY

Mr. SIKES. In regard to Fort Huachuca, when is it now planned that you will get underway with the electronic testing program which you have been discussing with this committee which involves the use of electronics systems under simulated battlefield conditions?

General TRUDEAU. Within 90 days.

Mr. SIKES. Is there a determination of who shall be awarded the contract?

General TRUDEAU. This is on the Secretary's desk and positive recommendations have been made.

Mr. SIKES. It will be done through contract?

General TRUDEAU. This is correct.

Mr. SIKES. You are now awaiting the decision of the Secretary on who shall actually receive the contract?

General TRUDEAU. That is correct, sir.

Mr. SIKES. You foresee no unusual difficulties in getting the program underway?

General TRUDEAU. We would not expect any.

Mr. SIKES. Is it a management or an operations contract?

General TRUDEAU. No, sir; it is an operations contract.

Mr. SIKES. Thank you very much.

Mr. FLOOD. Will you supply some information about body armor for the record?

General TRUDEAU. Yes, sir.

(The information requested follows:)

THE U.S. ARMY R. & D. PROGRAM FOR BODY ARMOR

The combined efforts of the Army technical services are coordinated in this program by the Army Quartermaster Corps which has primary D/A responsibility. These technical service efforts cover such aspects of the overall program as fragmentation type weapons, ballistic materials and tests, aircraft vulnerability and lethality studies, wound effects, land mines, protection required by mine clearance personnel, and compatability of body armor with chemical protective equipment and other equipment of the individual soldier. By means of an interservice standardization group the Army keeps abreast of and utilizes the work of the Navy and the Air Force.

Recent accomplishments in this field include the design testing of an armored vest incorporating a ballistic collar to decrease neck wounds. It is expected to reduce wounds in this vital area by 11 percent based on Korean war experience figures. A new composite armored vest of titanium plates and nylon fabric is undergoing engineering design tests. The titanium-nylon combination provides a significant increase in protection against the more modern ammunition for the same total weight per vest.

The Army has recently standardized and industry is producing for issue to the soldier in the field a nylon ballistic liner for the combat soldiers steel helmet. The new liner affords the first real increase in ballistic head protection since World War II. For the use of soldiers engaged in mine celarance we are currently field testing an ensemble consisting of head armor, and upper and lower torso armor. This is a significant step in providing real protection for our troops engaged in this important work.

Our materials research program is continually surveying and testing newly developed materials. Among these are new alloys of magnesium, aluminum, titanium, various ceramics, plastics, and fabrics. Combinations of materials have proven of real interest since the discovery of the effectiveness of the titanium-nylon composite.

Numerous problems remain to be solved in this program. One is the development of eye armor that would be transparent and optically satisfactory. An armor device that will protect the eyes from the dazzle of a nuclear burst is also being sought. A more effective means, light in weight, of protecting the feet and lower limbs from antipersonnel mines is another of our unsolved problems. The new combat boot described to the committee, is a step in this direction. Significant scientific breakthroughs in the armor materials, eye armor, and foot protection field would go far toward enabling us to make outstanding and long-lasting improvements in the body armor protection afforded the U.S. Army soldier.

Mr. MAHON. Thank you very much, gentlemen. You have been very helpful.

TUESDAY, MARCH 15, 1960.

CHEMICAL, BIOLOGICAL, AND RADIOLOGICAL WARFARE

WITNESSES

MAJ. GEN. MARSHALL STUBBS, CHIEF CHEMICAL OFFICER
MAJ. GEN. DAVID W. TRAUB, DIRECTOR OF ARMY BUDGET, OCA
COL. S. E. BAKER, DEPUTY ASSISTANT CHIEF CHEMICAL OFFICER FOR PLANNING AND DOCTRINE
COL. HARRY C. GILBERT, COMPTROLLER, OFFICE OF THE CHIEF CHEMICAL OFFICER
COL. THOMAS J. SHANLEY, CHIEF, ATOMIC-CBR DIVISION, OFFICE OF DEPUTY CHIEF OF STAFF FOR OPERATIONS, DA
LT. COL. ROBERT D. GEORGE, OFFICE OF DIRECTOR OF ARMY BUDGET, OCA
DR. WILLIAM H. SUMMERSON, DEPUTY COMMANDER FOR SCIENTIFIC ACTIVITIES, U.S. ARMY CHEMICAL CORPS RESEARCH AND DEVELOPMENT COMMAND
DR. ROBERT J. GOODLOW, DIRECTOR, BIOLOGICAL RESEARCH, U.S. ARMY BIOLOGICAL WARFARE LABORATORIES, FORT DETRICK, MD.
DR. DALE W. JENKINS, CHIEF, ENTOMOLOGY DIVISION, U.S. ARMY BIOLOGICAL WARFARE LABORATORIES, FORT DETRICK, MD.
O. R. MULLEN, LOGISTICS PLANNING DIVISION, OFFICE OF THE CHIEF CHEMICAL OFFICER

Mr. MAHON. We are now going to have a special presentation relating to some aspects of chemical warfare. You may proceed, General.

General STUBBS. Mr. Chairman and members of the committee, I am Maj. Gen. Marshall Stubbs, Chief Chemical Officer, U.S. Army. The presentation I will give is classified "Secret," sir, although we do have an unclassified version which is prepared here.

Mr. MAHON. Very well.

GENERAL STATEMENT OF CHIEF CHEMICAL OFFICER, U.S. ARMY

General STUBBS. I am glad of this opportunity to appear before this committee to discuss the Army's chemical, biological, and radiological programs. I can report to you that significant progress has been made in this area since I appeared before your committee last year—not only by the Chemical Corps but, more important, by the entire Defense Department. This is important, in view of the rapid technological advances that are taking place in the chemical and biological sciences throughout the world.

Today there is greater awareness both of the threat and, more positively, of the vital importance to our own posture of a strong capability in these weapons. This awareness exists not only in the military departments but within the Congress as well. I am referring, of course, to the hearings of the House Science and Astronautics Committee held in the first session of this Congress and to the splendid report, "Research in CBR," published by that committee, with which I am certain you are familiar.

Let me single out some of the more significant actions which have taken place in recent months. A little less than a year ago the Defense Science Board issued a report which pointed out inadequacies in our defense posture in the chemical and biological fields and recommended that immediate action be taken to provide an increased research and development program in these areas. This report initiated a series of actions by the Director of Defense Research and Engineering, among the most important of which are the following:

(1) Increased research and development funds have been provided. The fiscal year 1960 research and development budget for the chemical and biological program was originally $38 million. This has been increased to $42 million so far this year. We anticipate that several additional millions will be added for overall increase in this effort to a total of about $47 million for this fiscal year. With respect to fiscal year 1961 funding, this budget request includes $55 million for the Army's chemical and biological research and development program.

(2) We are continuing our efforts to make as much factual information available on the threat and potential of chemical and biological weapons as permitted by national security considerations. This is to insure provision of factual information at all levels both within and outside the military structure. I consider it vital to secure the maximum participation and contribution of the scientific community of the free world. I feel very strongly that we must leave no stone unturned in our efforts to match or surpass any potential enemy in the technological race in which we are engaged. This information effort offers one of the best means to secure this participation.

Last year, in my presentation to you, I summarized the characteristics and capabilities of chemical and biological weapons, intelligence information about Soviet activities, and our own status and future prospects in these areas. Today's presentation will be concerned primarily with three specific subjects of the Chemical Corps' research and development program which I believe will give you some insight into our scientific endeavor, and with a fourth which will discuss concepts of use of chemical and biological weapons. I have brought with me four assistants who can speak authoritatively about their particular fields of endeavor. In these presentations you will be given examples of what progress we are making and plan to make in applying the rapid advances in science and technology to chemical and biological weapons and to our defense against them.

I would first like to present Dr. W. H. Summerson, Chief Scientist of the Chemical Corps Research and Development Command, who will speak on our present and projected chemical agent research and development program. Dr. Summerson was born in Alabama, and earned his Ph. D. in biochemistry at Cornell University in 1937. Later he was on the teaching staff of Cornell University Medical School and reached the rank of associate professor of biochemistry in 1946. In 1947, he joined the Chemical Corps as Chief of the Biochemistry Branch of the Chemical Warfare Laboratories at Army Chemical Center, Md., and was appointed to his present position in 1959.

Dr. Summerson is the author of numerous publications in the field of biochemistry and toxicology, and is a member of a number of pro-

fessional societies. He is a fellow of the New York Academy of Sciences. I consider him eminently qualified to discuss this subject.

Statement of Deputy Commander for Scientific Activities, Research and Development Command

Brief Biographical Sketch

William H. Summerson was born in Decatur, Ala., April 12, 1906. He received the degree of B. Chem. from Cornell University in 1927, followed by M.S. (physical chemistry, 1928) and Ph. D. (biochemistry, 1937). He is a graduate of the Command Management School, Atomic Weapons Orientation Course, and Atomic Weapons-Guided Missiles Course.

He was on the teaching staff of the Department of Biochemistry at Cornell University Medical School in New York from 1929 to 1947, reaching the rank of associate professor of biochemistry in 1946. In 1947 he went to the U.S. Army Chemical Corps Laboratories, Army Chemical Center, Md., as Chief of the biochemistry section and in 1959 was appointed to his present position of deputy commander for scientific activities, Research and Development Command.

He has approximately 40 publications in the field of biochemistry and toxicology. He is coauthor of the 12th (1947) and 13th (1954) editions of the well-known textbook, "Practical Physiological Chemistry" by Hawk, Oser, and Summerson. He is a member of a number of professional societies and is a fellow of the New York Academy of Sciences.

Search for New and Improved Chemical Agents

Dr. Summerson. The purpose of my presentation today is to describe for you one specific technical area of current and expanding interest in the chemical and biological warfare program. My colleagues, Dr. Goodlow and Dr. Jenkins, will present information in two additional areas. Our presentations are designed to show you the type of problems we face and our approach to the solution to these problems. I have selected for my presentation the problem of the search for and the discovery of new and improved chemical agents.

The problems of the Chemical Corps in discovering new agents are not quite the same as those of industry in the search for new chemicals. We have certain basic requirements which must be met before an agent can be considered suitable for military purposes. These are—

1. Biological effectiveness.
2. Mass production from noncritical raw materials.
3. Dissemination by feasible munitions.
4. Stable in long-term storage.
5. Difficulty of protection, detection, decontamination, and treatment.

We frequently find an interesting new chemical compound which meets certain of these criteria but not all of them. It is not an easy task to find an agent which meets all the requirements.

Lethal Agents

In our search for new chemical agents we are looking for two general classes of compounds. The first class includes the lethal agents comparable to those we now have such as the nerve gases. To improve our posture in the lethal agent field we seek agents which act by a mechanism different from that of nerve gas action, so that an enemy cannot defend himself by measures which he may have developed for defense against the nerve-gas type of agent. We also seek agents which are much more effective than those we now know.

Examples of substances in these two different categories will be given shortly. The second type of agent for which we are searching has been called the incapacitating type agent. These are substances which at ordinary field dosages render the enemy incapable of continuing to fight but do not cause death. Agents of this type have an obvious desirability under certain military situations, as for example in so-called limited wars fought over territory containing mixed friendly and enemy personnel. For incapacitating agents we seek compounds of two general types. One type is sometimes called the psychochemicals; these agents incapacitate by acting on mental processes in such a way as to render the individual unwilling to carry out normal military duties. The second type of incapacitating agents act by other than mental effects, for example, to produce physical immobility as by paralysis, anesthesia, narcosis, and the like. Examples of promising compounds of these two types will be given shortly.

We can measure our progress in our search for new agents by various yardsticks. One simple yardstick is biological effectiveness, or potency. It is possible to express biological effectiveness of lethal agents on a scale where the scale represents the lethal dose to man in milligrams. On this scale we may show the position of practically all known lethal compounds. At one end of the scale we may place cyanide which is the least lethal of the agents we are considering. The effective dose for cyanide is approximately 70 milligrams per man which represents as a liquid about two small drops.

Other World War II agents such as phosgene and mustard were somewhat more potent, but not much so. The nerve gases discovered in the hands of the Germans after World War II are at least one order of magnitude more lethal than our World War II agents. For example, the lethal dose to man of the nerve gas, GB, is estimated to be 1 milligram which is approximately one-fiftieth of a drop.

It is possible to evaluate our search for incapacitating agents using the same yardstick; namely, biological effectiveness. Here, however, we mean not a lethal dose to man, but an incapaciting dose to man. For all the substances with which we are concerned the lethal dose to man is at least 100 to 1,000 times as high as the effective incapacitating dose.

This concludes my presentation. In the brief time available I have tried to give you an overall picture, somewhat quantitatively, of the present status of the research and development program of the Chemical Corps in its search for new and improved lethal and incapacitating chemical agents.

Mr. MAHON. Thank you, Doctor.

General STUBBS. In the biological field, scientists have reached the state where it appears practicable to produce genetic changes in microorganisms and thus create new biological agents with specific characteristics for specific purposes. Against such agents, our natural immunity and vaccines would be of little value. Dr. R. J. Goodlow, Director of Biological Research at the Biological Warfare Laboratories, Fort Detrick, Md., will discuss this subject. Dr. Goodlow was born in New Jersey and received his Ph. D. in bacteriology in 1941 from the University of Minnesota. He served 5 years in the Navy; 2 years as Supervisor of the Bacteriology Laboratories, Naval

Medical Center, Washington, D.C., and 3 years as an epidemiologist overseas with the 3d Marine Division.

Dr. Goodlow, who is the author of many publications in the biological field, joined the staff at Fort Detrick in 1949 and has served in his present position since Feburary 1958. I take pleasure in presenting him to you.

STATEMENT OF CHIEF, ATOMIC-CBR DIVISION, OFFICE OF DIRECTOR OF AIR DEFENSE AND SPECIAL WEAPONS

BRIEF BIOGRAPHICAL SKETCH

Dr. Robert J. Goodlow was born August 7, 1915, in New Jersey.

He received his Ph. D. in bacteriology in 1941 from the University of Minnesota.

He served 5 years in the Navy; 2 years as Supervisor of the Bacteriology Laboratories, Naval Medical Center, Washington, D.C., and 3 years as an epidemiologist overseas with the 3d Marine Division.

He is the author of approximately 22 publications which deal primarily with the effect of metabolitics upon growth, virulence, and population changes in cultures of microorganisms.

He has served on a number of international conferences and committees.

Dr. Goodlow joined the staff at Fort Detrick in 1949 as a bacteriologist and has served as Director of Biological Research and Acting Director of Allied Sciences since February 1958.

Dr. GOODLOW. Mr. Chairman and members of the committee, I would like to discuss with you today some of the major activities that fall under the heading of biological warfare research.

In this connection, a seasoned estimate of the overall program came last August 10 in the report of the Committee on Science and Astronautics, House of Representatives, Union Calendar No. 353, which General Stubbs mentioned earlier. In the view of this committee, and here I should like to quote from the report itself:

"Biological warfare is nothing new and mysterious and the agents that could conceivably be employed are the same diseases which public health measures and personal hygiene traditionally aim to thwart. In past wars, epidemics among men and epizootics among animals have often taken as many lives as the battlefield even though the diseases were spread by natural rather than artificial means. But biological warfare is something more in its potentialities. On a small scale, introduced by saboteurs, it might represent just a supplement to natural health hazards. But it could also be employed on a large scale without dependence upon epidemics as a means to reach a large target population."

I wish that time permitted the thorough examination that the committee report justly deserves. This quotation, however, stresses the simplicity of the fact that in order to perfect the means of defense against Mother Nature's biological threats to the health of mankind, our scientific laboratories must first establish how germs attack man, the conditions and means of onslaught, the results upon his system and the therapy that assures his survival. Thus, as knowledge of disease is gained, so also is gained an essential defensive knowledge. This is true of any weapon system or device that has a deleterious effect on men, food and animal.

Preparation, then, against the threat of biological warfare becomes a critical element of national defense planning whether you think in terms of large or small, conventional or nuclear wars. Yet, any na-

tion, no matter how small, which has a laboratory and scientists to staff it, has a biological warfare potentiality.

Chemical Corps studies of biological warfare over the past 18 years have afforded basis for great forward strides in medical science both of military and civilian application. In a way, our program turns out to be more of a melting pot than almost anything else in national defense. The ideas of the Army, Navy, Air Force and research agencies of the Defense Department; the thoughts of the Civil Defense Administration and the U.S. Public Health Service; the viewpoints of professional consultants; the ideas and advancements stemming from civilian scientific laboratories and from industry itself—all are considered by the Chemical Corps. From this flow of study, the most promising proposals, advancements and items that may have defense application are extracted.

The first and most readily available items for study are to be found in the approximately 160 cataloged diseases of man. These diseases and the organisms that cause them are well documented in the medical literature. In spite of our knowledge, opinions on the biological warfare significance of many of these diseases vary, depending often upon the personal experience of the individual rendering the opinion. To many persons, for example, an attack of influenza would be a completely incapacitating experience, whereas to others, a bout with this disease would simply be an inconvenience.

We have investigated a number of agents in our laboratories and in some respect all fail to meet the ideal criteria. Most of these agents, however, are adaptable to certain situations suitable for biological warfare and consequently have demanded our attention.

If the agents adaptable to biological warfare were limited to those that cause infectious diseases which are well documented in our medical literature, our defense problems would be greatly simplified. Unfortunately, however, this is not the case and it is for this reason that we must maintain a vigorous program of basic research in this field.

I should like now to consider a second source of biological agents. Every living population has one thing in common: the total population is a composite of individuals differing in some degree in one or more characteristics. Shifts in the total population balance are continually taking place, these shifts being controlled mainly by genetic and environmental selection.

I could predict with certainty that, should suitable members and types of both sexes be placed in this building, the doors barred and all physical needs of the individuals be taken care of, the population of this building after 1,000 generations would be entirely different from that which we see today. By genetic exchange, mutation, and selection, a new type of population would surely evolve.

In order to see the results of this "experiment," however, I would have to live another 33,000 years.

Genetically, a test tube of bacteria is essentially no different from a human population. By mutation and natural selection, changes occur in the bacterial population for better or for worse (depending on the point of view). A big difference between the bacterial population and the one in this room is that the generation time in bacteria can be as low as 3 hours compared with the average generation time of 33 years in man. In less than 4 to 5 months bacteria can evolve to the extent that would take man 33,000 years.

Therefore, a second source of potential agents constitutes those "sports," "freaks," or mutants that possess characteristics or advantages peculiar to biological warfare. Some examples of natural mutants are the antibiotic-resistant staphylococci, which are such a problem in many of our hospitals today, and other antibiotic-resistant bacteria such as streptococci, and gonococci. Obviously, the treatment of diseases produced by such agents is often a serious problem. The recent outbreak of Asian flu is an excellent example of a new, spontaneous, highly infective mutant of the well-known influenza virus against which the world population had little or no immunity.

We must always be on the alert for these new agents that appear spontaneously. As long as bacteria and viruses exist, mutation, selection and evolution will continue and be a source of new agents that may plague man.

Finally, we come to our third source of new agents—mutants deliberately induced by man in the laboratory. X-ray, ultraviolet light, and nuclear radiation are all tools whereby genetic modification of existing agents can be achieved. In the future of biological warfare, here lies our greatest threat. The ability of an enemy to deliberately create new and bizarre agents of disease against which our population had no defense would constitute, in my opinion, a weapon capable of destroying us.

Physical treatment is not the only method of altering genetic composition of micro-organisms. There is also a tremendous potential in deliberately "mating" strains of agents to produce new genotypes. Such processes are called transformation—the direct "mating" of two bacterial types produce progeny possessing properties of each of the parents. [Blackboard demonstration.] Another example of the progress made in the last decade by our microbial geneticists is the process of transduction—the interchange of genetic material from one bacterium to another through the intercession of bacteriophage, a virus parasitic to bacterial cells. It may be of interest to you to recall that the Nobel Prize in medicine in 1958 was awarded to the American geneticist Dr. Joshua Lederberg, who demonstrated this phenomenon. [Blackboard demonstration.]

Still another approach to the genetic control of microbial populations is the fractionation of viruses. Viruses have two active fractions, nucleic acid and proteins. Through various chemical procedures, it is possible to separate these two fractions and then recombine them with fractions from a different virus thus "creating" a new virus. [Blackboard demonstration.]

It is my belief that the next decade will bring us close to the understanding and control of many vital processes of living cells. The biologist, with his colleagues, the chemist, biochemist, physicist and biophysicist, is at the threshold of scientific discoveries that can benefit or destroy mankind.

Mr. Flood. What happened to Mendel's law up there?

Dr. Goodlow. Nothing happened to it.

Mr. Flood. This is asexual reproduction?

Dr. Goodlow. This is a type of sexual reproduction.

Mr. Flood. Asexual?

Dr. Goodlow. It is sexual to the point of the bacteriophage acting as a sexual agent. The transformation is more of a sexual process. I see your point.

Virus A, for example, can be broken up chemically into nucleic acid fraction and protein fraction. We do the same thing with virus B. We then have nucleic acid fraction B and protein fraction B. It is possible, it has been shown to be possible to combine these fractions producing a new type of virus, fractionation of virus is a terrific field.

Mr. SHEPPARD. One question before you leave. On the interbreeding of these cells where does diminishing return come in, if at all, or are we in a different phase?

Dr. GOODLOW. I do not quite get your question, sir.

Mr. SHEPPARD. You get an interrelationship there. You expanded it to several families. To what line of demarcation does that expansion go before there is either ineffectiveness or greater potentiality?

Dr. GOODLOW. I cannot answer the question, sir. It is brand new.

Mr. SHEPPARD. An unknown factor?

Dr. GOODLOW. Yes, sir.

Mr. FLOOD. You are suggesting that in all these mutations, even though you skip two, three, four, five generations, there exists some of the original strength of the original parent in the fourth, fifth, and sixth generations?

Dr. GOODLOW. Yes, sir.

Mr. FLOOD. By strength——

Dr. GOODLOW. No one knows.

Mr. FLOOD. Most probably it would?

Dr. GOODLOW. Yes, sir.

Mr. MAHON. Proceed.

SIGNIFICANCE OF DEVELOPMENTS

Mr. SIKES. In words of one syllable, what is the significance of the demonstrations you have just given insofar as this field of endeavor is concerned?

Dr. GOODLOW. Suppose, sir, we have a population that is immune to virus A. Suppose we cross virus A with virus B. We could conceivably come up with a virus which would do everything that virus A will do but still the population would be completely susceptible to this agent.

Mr. FLOOD. And you can quarantine it geographically, do you think? Can you put a "cordon sanitaire" around A, B, C, D areas, do you think, within reason?

Dr. GOODLOW. We hope so, because we are looking for noncontagion in these agents.

General STUBBS. It would depend upon method of transmission. If it is transmitted between individuals, this would be a real problem. If other than that——

Mr. FLOOD. Would these properties be both infectious and contagious or separate families?

Dr. GOODLOW. I think it is possible to breed anything you like into these things. I believe the future will bear me out on this.

Mr. FLOOD. Fascinating. If you could create a "cordon sanitaire" around a limited geographic area, once given susceptibility of that

population to this strain, then inject strain B into it to make them susceptible and quarantine it, my, what a nice game to play that is.

Mr. MAHON. We will meet again at 2 o'clock.

AFTERNOON SESSION

Mr. MAHON. Proceed with your additional statement, General.

General STUBBS. Another possibility is the use of insects by an enemy as a method of disseminating biological agents, a form of biological warfare usually called entomological warfare. Nature has been doing this from time immemorial through the mosquito, the tick, and the louse, to spread malaria, Rocky Mountain spotted fever and typhus.

We need only remember the effectiveness of the yellow fever epidemic against our troops in Cuba in the Spanish American War, and the problem it posed for us during construction of the Panama Canal before it was solved by Gen. Walter Reed, to realize what such warfare could accomplish. To discuss the subject of "Entomological Warfare," I have with me today Dr. Dale W. Jenkins, who has headed up the entomological program at the Biological Warfare Laboratories, Fort Detrick, Md., since 1953. Dr. Jenkins was born in Ohio and received his Ph. D. in medical entomology from Ohio State University in 1947. He served as an Army officer during World War II as a medical entomologist at the Medical Laboratories, Army Chemical Center. Dr. Jenkins is internationally recognized in the field of entomology and has been an invited speaker to international conventions and meetings as well as having served as a consultant to international groups.

Mr. MAHON. Dr. Jenkins, will you please proceed.

(The statement of Dr. Jenkins is classified and was presented off the record.)

BRIEF BIOGRAPHICAL SKETCH

Dr. Dale W. Jenkins was born June 17, 1918, in Ohio.

He received his Ph.D. in medical entomology in 1947 from Ohio State University.

From 1943 to 1945 he served as an officer in the Army as a medical entomologist at the Medical Laboratories, Army Chemical Center, Md.

Following his military service he served as chief of the animal ecology branch, Medical Laboratories, Army Chemical Center, until 1953 when he transferred to the Biological Warfare Laboratories.

Since 1953 he has headed up the entomological program at Fort Detrick. He was responsible for the entomology program progressing from concept to feasibility and from basic research to development of a completely new and potentially most effective BW weapons system.

Dr. Jenkins is internationally recognized in the field of entomology and has been an invited speaker to international conventions and meetings and has served as a consultant to international groups.

(Discussion off the record.)

General STUBBS. I am particularly pleased to have Col. Thomas J. B. Shanley, the next speaker, as a member of my team today. Colonel Shanley was born in Butte, Mont. He is an infantry officer and a graduate of the U.S. Military Academy, the Command and General Staff College, and the National War College. During World War II, he served as a battalion commander and regimental executive officer with the 82d Airborne Division. He was commanding officer of the 19th Infantry, 24th Division in Korea after the war. Colonel

Shanley is now Chief of the Atomic-CBR Division, Office of Director Air Defense and Special Weapons, in the Office of the Deputy Chief of Staff for Operations, Department of the Army.

This presentation, the subject of which is "Potential Military Application of Chemical and Biological Weapons," has been made within the Department of Defense by Colonel Shanley to the Army Chief of Staff, the commanding general of the Continental Army Command, the Deputy Chief of Staff of the Marine Corps, the staff and faculty of the Command and General Staff College and to the Army Policy Council. I am confident you will consider this presentation of significant interest.

STATEMENT OF CHIEF, ATOMIC-CBR DIVISION, OFFICE OF DIRECTOR, AIR DEFENSE AND SPECIAL WEAPONS

(Colonel Shanley's discussion is classified and was presented off the record.)

(A brief biographical sketch of Colonel Shanley follows:)

Thomas J. B. Shanley was born in Butte, Mont., December 17, 1917. He was graduated from the U.S. Military Academy as an infantry officer in 1939. He is also a graduate of the U.S. Army Command and General Staff College and the National War College. He earned his Ph. D. degree in physics from the Graduate School of Princeton University in 1951.

During World War II, Colonel Shanley served as a battalion commander and regimental executive officer with the 508th Parachute Infantry Regiment, 82d Airborne Division. He was commanding officer of the 19th Infantry, 24th Division in Korea after the war, and senior adviser to the 9th ROK Division, KMAG, AFFE/8A.

Colonel Shanley is now Chief of the Atomic-CBR Division, Office of Director Air Defense and Special Weapons, in the Office of the Deputy Chief of Staff for Operations, Department of the Army.

His decorations include the Silver Star, Bronze Star with cluster, and the Purple Heart, together with foreign decorations.

EFFECT ON ANIMALS

Mr. FLOOD. What about animals?

Colonel SHANLEY. Agents which are effective in animals will infect animals exposed to them.

Mr. SIKES. What kind of comparison could you give us to show the number of sorties required to mount a conventional high explosive attack on an area of this sort? Do you have that information?

Colonel SHANLEY. I do not have exact information at hand, but it would be a great many sorties.

Mr. SIKES. Is it true that a conventional attack using high explosives would require many times this number of bombers?

Colonel SHANLEY. Yes, sir; that is correct.

Mr. FLOOD. You think the caribou would be safe? What I am concerned about is in the case of a friendly area where you have an incapacitation mission. You do not want to destroy their farm production.

Dr. GOODLOW. Yes, sir; that is an important point.

Mr. FLOOD. It depends on the agent?

General STUBBS. On the agent.

Mr. FLOOD. It could be very unfriendly.

General STUBBS. Yes.

(Discussion off the record.)

Colonel SHANLEY. Sir, that concludes my part of the presentation.

General STUBBS. It has been a pleasure to be here and discuss our programs with you. I hope we have given you additional insight into what we are doing and hope to accomplish. The increase in funds we shall receive will largely be spent by contracts with universities and research organizations, thus making fuller use of the scientific competence of the Nation. The increased awareness of chemical and biological weapons everywhere has added immeasurably to the national security. If we continue to broaden this awareness, our defenses against these weapons will be sufficient to guard against their use by an enemy. This is my main concern: The defense of the Nation. In this regard, I should mention the recent report on CBR defense of the American Chemical Society Committee on Civil Defense. This report highlights the importance of furnishing information required by the people to understand and protect themselves against chemical and biological warfare. We need more reports of this kind. I will have copies of this report distributed to you.

This concludes the Chemical Corps presentation. I would welcome any questions you may have. Thank you.

PRACTICALITY OF OPERATION

Mr. MAHON. Thank you, General Stubbs, for a very interesting presentation. You have given us a better insight into the problem involved here. I admit that before some of us will fully understand all of the implications of this program considerably more briefing and study would be required.

Would it be practical for an opponent to use this sort of an approach to attack a large country like the United States?

General STUBBS. We feel that it is, sir. We are looking just a little bit to the future in our own programs, sir. We feel it is technologically practical to have dry biologic agents. For instance, we feel that 10 carriers distributing 10,000 pounds each could mount such an attack.

Mr. SIKES. Ten airplanes?

General STUBBS. I am trying not to make that too specific because they could be 10 airplanes or 10 missiles. On the other hand, each time the statement is made the question is asked—how are 10 airplanes going to fly tree top for a thousand miles say across the United States? My only comment here is that they would go up to 30,000 feet and drop the packages down and do the same job you would at the lower level. With 10 carriers dropping 10,000 pounds each, it would mean that with dry biological warfare material, we feel a potential enemy would get at least 30 percent casualties in the total of the United States.

Mr. MAHON. Off the record.

(Discussion off the record.)

Mr. MAHON. Mr. Sikes.

CHOICE OF AGENT

Mr. SIKES. If you had the capability to utilize a BW or CW agent of your choice in the hypothetical situation which the chairman described, what agent would you use and how quickly would it be effective?

General STUBBS. In the situation the chairman mentioned, the most effective agent and the one that we have most quickly available is the one ———. This will last for a period, depending on the dosage received, from 1 to 24 hours. This lays people down so that you have time to go in and take over and control the situation. It is one that would be taken in through the respiratory tract.

Mr. FLOOD. We do not want to win. We do not want to kill too many people. We do not want to hurt too many people. We must recondition the whole mind of the American people and our allies that we are going to fight wars for generations that we may start in some cases, without intending to win, and do not want to win, when the other side starts it. We will have to try and condition the American mind that when you start a war you do not have to win it. That is obsolete. That is nonsense.

The kind of warfare that we are talking about and thinking about, the last thing in the world you want to do is to win the darn thing. What do you do when you do win? We never get to that. What is your combined intelligence on your opposite numbers in Russia, particularly Russians?

SOVIET OPERATION

I understand he does not give this to his satellites.

We heard for an hour or two hours from General Trudeau that in the entire Western Front, with the Russians with dozens of divisions in the line, that one-sixth of his total combat ammunition inventory of hardware is chemical warfare, trained, experienced, and with troops in the field, last night. One-sixth of his Western Front attack potential is chemical warfare.

What are you doing, just playing games here?

Mr. MAHON. Mr. Sikes?

ANTIBIOLOGICAL WARFARE AND ANTICHEMICAL WARFARE PROPAGANDA

Mr. SIKES. General Stubbs, I think you have given valuable service here today with your testimony and that of your staff. I have noted a pattern of antichemical warfare and antibiological warfare propaganda which constantly appears in publications of a certain type and comes from certain organizations.

These publications and these organizations do not seem to be particularly disturbed about the horrors of other types of war, mass slaughter and mass destruction by atomic bombs, death from burning by napalm; none of these things seem to bother them, but they are very much perturbed about the use of CBR. They appear greatly excited by single proposals that the United States achieve a defense capability in CBR. I do not assume these people in league with our enemy, and I am sure that most of them are not, but I am unable to understand their indifference to the horrors of war other than CBR. Is there a possibility that these people are unwittingly playing into the hands of our enemy who would like to keep us weak, at least in one major field of defense? A major weakness certainly invites attack and the Communists have the capability for attack.

Do you think this might be a deliberate pattern which is encouraged by Communist agents?

General STUBBS. It is my personal belief that this has been a pattern of long standing, that the Russians have used this as propaganda against the United States, citing a couple of instances here.

In the case of the Korean war, they accused us of biological warfare and this made great propaganda and benefits to the Russians. At the same time, in the things they accused us of doing, it showed us that they had information that we did not have at that time about handling this kind of a thing.

Mr. FORD. What do you mean by "handling this kind of a thing"? From the propaganda point of view or weapons?

General STUBBS. In the handling of biological materials, those things that they accused us of doing. For instance, they accused us of using mosquitoes that were frozen and dropped over the country and then, when the natives started their campfires, they melted the ice and the mosquitoes came up and bit them and gave them a disease. It is possible, and we find that you can have mosquitoes that are disease carriers. There are some types of mosquitoes—and they happen to be up in the northern part—the people in the Arctic have mosquitoes that just come out from the ice and come out and bite. This is what I am told.

Mr. FLOOD. You have heard the theory expressed that the Russian always exposes his hand by accusing you of what he, himself, can do. All of these bacteriological and chemical warfare indictments against you, show what he stands ready and is capable of doing, and you are not.

General STUBBS. I think it is this kind of thing that dropped us as a free world, not only this Nation, but the free world, into this trap, if I may use it that way, of saying that we have been on the defensive. We have not had reason to be on the defensive against him anyplace in the free world, so our free world thinking is that these are terrible things.

INVITATION TO VISIT LABORATORY

General STUBBS. May we ask you to come out and visit our laboratory and see what we are doing?

Mr. FLOOD. Yes.

General STUBBS. It is so interesting when you get out to see it, and see that kind of thing and how much we do need. We must reach the whole free world, I feel, to contribute to this program.

Mr. FLOOD. I think I have the kind of mind that would lend itself to this.

You seem to be much too nice a guy.

STATUS OF EQUIPMENT

Mr. SIKES. Let me ask a question in that connection.

CBR has had very small appropriations and most of its work has been in research and development, but what about the availability of modern equipment, equipment devised since World War II for use in World War II plants with post-World War II equipment? You have a fair amount of World War I period equipment, but what do you have in the way of new equipment; other than test equipment?

General STUBBS. Nothing new in the biological warfare field.

Mr. SIKES. You have designed new equipment but you have not had an opportunity to produce it for our military inventory; is that correct?

General STUBBS. That is correct.

(Additional classified info will be furnished separately.)

Mr. SIKES. Does this budget permit any capability in new equipment, or is it still primarily a research and development effort?

General STUBBS. While this is primarily a research and development effort, sir, the 1961 program will provide us with a number of T–238 rockets.

Mr. SIKES. Is that about all?

General STUBBS. That is the major item, plus some masks.

LEADTIME

Mr. FLOOD. There is this advantage. The leadtime on aircraft is 3 to 5 years.

Mr. SIKES. What is your leadtime situation? Are these new items of equipment at a point that they can speedily be converted into an inventory? By speedily I mean 3 months or 6 months. Do you want to prepare information for the record on that?

General STUBBS. That would assist. This is a broad subject. I can attack it four or five different ways.

Mr. FLOOD. Also the leadtime on your ammunition, which is of whatever category or types you are talking about.

General STUBBS. After we have received a new chemical or biological item from development the production leadtime for its manufacture will vary depending on the availability of facilities. In those cases where facilities are in existence the normal end-item leadtime ranges from 3 to 12 months at which time the first items would become available. If new facilities are required, the average leadtime ranges from 18 to 24 months including the construction leadtime.

RADIATION

Mr. FLOOD. You have said absolutely nothing about radiation as an active field weapon as distinguished from fallout from an atom bomb, radiation as a weapon for limited field action, for broader areas, for cordoning off an entire operational sector, keeping it unhealthy or clean or dirty for X hour or X days, et cetera. You have seen the Russian papers on this.

General STUBBS. We feel the use of radioactive materials as a weapon has a very definite application. We feel we have proven the feasibility of the delivery of these materials.

(Discussion off the record.)

Mr. NORRELL. Will the gentleman yield?

Mr. SIKES. Yes.

COMMENDATION

Mr. NORRELL. I would like to make this statement. General Stubbs, I have known something about the U.S. Army so far as general warfare is concerned for some time and also especially regarding the Chemical Warfare Service. I think they have done

a marvelous job, not in trying to destroy human life, but keeping our enemies from destroying us. I want to say that as far as the Chemical Warfare Service is concerned in the U.S. Army, I know something about it. I know of no organization that has done a more marvelous job than the Chemical Warfare Service has done.

I know most of the men in charge of the arsenal in Arkansas. They have done a splendid job, and I have known some of them in other sections of the country. I cannot pay too high respect and admiration for the work you have done, that you have always done.

In regard to their enemies, they have an idea that the only thing they can do is kill people. We do not feel that way about it. We want to save human life. You have done more trying to save human life in World War II, the Korean invasion, and other wars we have had, and I cannot pay too high respect to you for the Chemical Warfare Service.

Thank you very much.

General STUBBS. Thank you, sir.

SOVIET VERSUS U.S. CAPABILITY

Mr. SIKES. General, I am going to ask you a number of questions, some of which you may want to call on members of your staff to answer. Do not hesitate to do so if that is desirable.

When you were before this committee a year ago you described the Soviet effort in CBR, and indications are that those efforts are being intensified and improved.

Would you briefly compare our capability to wage offensive CW and BW warfare with the capability of the U.S.S.R., based on latest intelligence data known to you?

General STUBBS. Colonel Baker, will you respond to that question, please.

Colonel BAKER. First, Congressman Sikes, we credit to the Soviet the ability to wage biological and chemical warfare on a large scale, that he possesses a tremendous capability in chemical warfare.

Mr. SIKES. What about modern equipment with which to disseminate those agents?

Colonel BAKER. To make one example, sir, they have very modern equipment. Throughout their army there are a great number of rockets. Rockets are fine weapons for disseminating chemical agents.

This is an example. They have all the artillery weapons we have and they run into large calibers.

The Soviets are credited with having a G-type agent. We believe they have a type of agent defined or described as GA compared to GB. Each is quite lethal.

Soviet biological research and development began in the thirties.

Mr. FORD. Will the gentleman yield?

Mr. SIKES. Yes.

ALLIED CAPABILITY

Mr. FORD. Do any of our Western Allies in Europe have any capability whatsoever in any of these fields, any significant capability?

Colonel BAKER. ———.

Mr. FORD. What about the West Germans?

Colonel BAKER. The West Germans do not and are prohibited from dealing in offensive BW and CW by the most recent treaty.

Mr. FLOOD. Including gas.

Colonel BAKER. Yes, sir.

Mr. FORD. They had a great know-how and capability in World War II.

Colonel BAKER. Tremendous know-how and the nerve gases are their products. What we know about we started from there and have gone forward.

SATELLITE CAPABILITY

Mr. SIKES. What about the satellites, particularly the Chinese Communists? What do you know about their capability in CBR?

Colonel BAKER. ———.

GERM WARFARE

Mr. MINSHALL. If the gentleman will yield, are you going into the germ warfare capabilities of the Russians or has he answered it?

Mr. SIKES. This has been answered, at least in part. If you have any specific information you want to ask, go ahead and do so.

Mr. MINSHALL. I would like to ask this at this point. Have the Soviets proceeded any further than the R. & D. stage with their germ or nerve or gas warfare?

Colonel BAKER. ———.

Mr. MINSHALL. They are in procurement; is that correct?

Colonel BAKER. ———.

Mr. MINSHALL. Thank you.

PLANS FOR EXPANSION

Mr. SIKES. Since you are to expand somewhat under this year's budget, give us some information about your plans for expansion. What are the guidelines and dollar figures to be made applicable to this expanded program for fiscal 1961 and for the immediately following years, insofar as you can determine? Is this proposed funding adequate?

General STUBBS. I will ask Mr. Summerson to answer that. We have discussed the 1961–62 figure. Dr. Summerson has a chart that we have used in other explanations. I do not want to imply here that this is anything but our own thinking.

Mr. SIKES. Give us the details on that subject for the record, but please summarize it now.

Dr. SUMMERSON. I will be happy to. This is the Chemical Corps 5-year program as we see its requirements and the objectives we hope to achieve.

(Subsequent to the request of Mr. Sikes, Dr. Summerson gave a detailed picture of the 5-year program which follows:)

Dr. SUMMERSON. This is the Chemical Corps' program for a 5-year R.D.T. & E. funding effort. At the present time the current budget, fiscal 1960, is at a level of $42 million. As General Stubbs indicated, we expect to receive shortly about $5 million of emergency funds to help us accelerate into the fiscal year 1961 budget, which is at a level of $55 million.

[Off the record.]

With this budget—and this bears on something Congressman Flood asked about and also that you asked about, Congressman Sikes—we expect to have in the time frame 1963 to 1965, a program to give us for defense the following items: An improved alarm for the rapid warning of chemical agents; vaccines for defense against those BW agents where vaccines are known to be satisfactory at the present time, and we expect to have adequate nerve gas treatment.

If the program continues, the scheduled type classification of these various BW agents is as indicated on the chart.

(A classified chart will be furnished separately.)

Mr. FORD. Does that program give us a good, strong, adequate military program in these areas?

Dr. SUMMERSON. This is exactly what it is supposed to do. This is the objective that was set for us by higher authority. As we see it, we will have an extremely strong program in this time frame if we can continue on our present course.

Mr. FORD. With these kinds of funding programs now and for the next 3 or 4 years?

Dr. SUMMERSON. Off the record.

(Discussion off the record.)

Mr. SIKES. This is very interesting. Your increased research and development program, we assume, is underway. What about your plans for bringing new defensive items into the supply system? In other words, will your production effort be in step with your research and development effort?

General STUBBS. We plan this to be so. As to 1961, we have requested money to provide for this. It is in 1962 and beyond that we are going to really be reaching for additional funds.

INTERSERVICE SUPPORT

Mr. SIKES. You are primarily an Army agency, but you have responsibility to other Government agencies such as Air Force, Navy, and Marines. Would you explain what this means and tell us how you go about developing firm requirements for these services?

General STUBBS. We do have the responsibility for research and development for joint use within the Department of Defense, or at least the supervision and the coordination of research and development within the Department of Defense for chemical and biological warfare——

(Discussion off the record.)

General STUBBS. What we have been attempting to do is inform the other services as to what the capabilities of these materials are. We feel this is our job. I do not wish to be in any way condemning anyone, but this time we have not gone as far, if I may put it this way, as we feel we should go——

(Discussion off the record.)

PERSONNEL

Mr. SIKES. Since this program is expanded to some extent, will there be an increased requirement in scientific and professional ceilings?

General STUBBS. What we are trying to do here, sir, is exploit the scientific abilities within industry and the educational institutions of the United States and the free world, as far as that is concerned, to see how far we can go, using the mechanism of contracts.

Mr. SIKES. Do you have to obtain additional know-how from as many people as possible because of previous limitations in funding?

General STUBBS. Yes, sir. We will have to broaden our base and increase the numbers of outside people actually working with these materials. If we are unsuccessful in this, then to prosecute the program strongly we certainly will have to have increased personnel ceilings.

Mr. SIKES. Will you be able to obtain the personnel you need? Are they available?

General STUBBS. This is going to be a real problem to the Department of the Army or the Department of Defense. With decreased ceilings, people, for us to get them, will have to be taken from someone else.

Mr. SIKES. Are you going to require additional military personnel?

General STUBBS. Yes, sir; I feel we will require a considerable increase in our military personnel.

Mr. SIKES. In what areas do you think the most significant increased manpower requirements are likely to occur?

General STUBBS. This is going to be across the board pretty well. May I make one mention such as the officer personnel. Here the Soviets have their field specialists, such as chemical corps types of people, down to their battle group level. We do not. We have it down only to the division level at this time. For us to go down to the battle group level would require many more people.

Mr. SIKES. Are you particularly handicapped now by the authorized personnel ceilings, both in the headquarters in Washington and in the field activities?

General STUBBS. We have our problems in this area.

CONTRACT OPERATIONS

Mr. SIKES. Can you tell this committee what the approximate percentage of your expanded CBR program for this fiscal year and the foreseeable future fiscal years is planned for contractual effort, with such agencies as universities, nonprofit institutions, and private contractors? Give examples of those.

General STUBBS. In the current fiscal year, 1960, approximately 18 percent of our R.D.T. & E. budget has been or will be placed for contractual effort with outside agencies. In fiscal year 1961 we expect this effort to rise to approximately 33 percent of the total R.D.T. & E. program and in fiscal year 1962 we expect the figure to be approximately 43 percent. We plan to approach the level of approximately 55–60 percent in the fiscal years beyond fiscal year 1962. This is in consonance with the directive issued by the Chief, Research and Development that 90 percent of R.D.T. & E. funding increases above the fiscal 1960 level will go to industry, private laboratories and institutions.

As examples of the type agencies which we now utilize for contractual effort, in the university field we may cite the University of Pennsylvania, Harvard University, Rutgers University, the Univer-

sity of Maryland, George Washington University, and many others. Nonprofit institutions include Stanford Research Institute, Battelle Memorial Institute, Armour Research Institute, Southern Research Institute, and others. Private contractors include the Olin-Mathieson Corp., Radio Corp. of America, Mine Safety Appliance Co., Farrand Optical Co., Harris Laboratories, Hazelton Laboratories, and many others.

OVERALL REQUIREMENTS

Mr. SIKES. This question pertains again to the expanded CBR program, looking more specifically past the R.D.T. & E. efforts. What are your requirements in addition to R.D.T. & E. funds for production facilities, stockpiles, and this type operation? Will this requirement recognize and include requirements for other claimants such as Air Force and Navy?

General STUBBS. In addition to R.D.T. & E. funds, Chemical Corps planning forecasts Army fund requirements for production facilities and stockpiles totaling approximately ——— during the period fiscal year 1960–65. This figure recognizes production facilities for Air Force, Navy, and Army CBR requirements but includes only funds for Army stockpiling requirements. A major portion of these funds are for vastly improved CBR defensive posture, increased capability for employment of CW and production facilities for BW munitions.

NEW PROTECTIVE MASK

Mr. SIKES. Last year you discussed the introduction of a new protective mask. How are you getting along? Are you on schedule with your development and production?

General STUBBS. The M–17 field protective mask was standardized on schedule during the third quarter of fiscal year 1959, and a contract was placed during the fourth quarter of fiscal year 1959 for 12,000 M–17's, with initial delivery scheduled for March 1960 and completion during the fourth quarter of fiscal year 1960.

A contract for procurement of an additional 207,000 M–17's was placed during the second quarter of fiscal year 1960. The latter quantity includes 32,000 for Marine Corps. Delivery of masks on the latter contract is scheduled to begin during the first quarter of fiscal year 1961 and to be completed during the fourth quarter of fiscal year 1961. Army production is planned at the rate of 40,000 masks per month.

Mr. SIKES. While on the subject of protective masks, may I inquire about the civil defense mask about which we hear various things from time to time. Is the Chemical Corps involved in developing such a mask? Is it ready to go? Who is responsible for this mask?

General STUBBS. The Chemical Corps has developed an efficient, inexpensive, and comfortable mask for civilian defense needs. It is ready to go as you put it. In supplying items to agencies outside the Army, we must have quantitative requirements and sufficient fund allocations before we can enter into a procurement contract. The Office of Civil Defense Mobilization is presently working up their requirements for this mask and have advised that $100,000, the initial increment of funding for the procurement of civilian protective mask, will be made available during the fiscal year, 1960. Further responsi-

bility for this mask, such as supply and distribution, rests with the Office of Civil Defense Mobilization.

NEW TOXIC AGENT

Mr. SIKES. Last year you told us about your progress in introducing a new toxic gas into the defense arsenal. Do you have any progress to report? I would like to hear the latest on this new agent.

General STUBBS. The Department of the Army (Corps of Engineers) awarded a contract on June 23, 1959, to the Food Machinery & Chemical Corp. for the design and construction of a new chemical agent production facility at Newport, Ind. The construction site is at the U.S. Army Wabash River Ordnance Works, utilizing facilities previously occupied by the U.S. Atomic Energy Commission's Dana Heavy Water Plant. The facility will be known as the U.S. Army Newport Chemical Plant.

(Additional information is classified and will be furnished separately to the committee.)

NEW CHEMICAL ROCKET

Mr. SIKES. Last year you presented movies of the new chemical rocket. What is its present status?

(The answer to be supplied is classified and has been furnished separately to the committee.)

Mr. SIKES. Thank you, Mr. Chairman.

Mr. MAHON. Mr. Flood.

CBR GAP

Mr. FLOOD. There is one thing that is as plain as the nose on my face—and I have more than my share of nose. There may be some debate as to whether or not there is a missile gap, but there can be no intelligent debate about the fact that there is a shocking and appalling, great, big, wide CBR gap; is that not true?

General STUBBS This is my opinion, sir.

Mr. FLOOD. If it were to the contrary, you would know, would you not?

General STUBBS. I would, sir.

Mr. FLOOD. Your opinion has every reason to be a pretty sound one, since you are the skipper of this ship; is that right?

General STUBBS. Yes, sir.

Mr. FLOOD. A very diabolical thing about this is Soviet Russia has an active, operational, substantial field capability with troops in all of these areas. We even suspect radiation as a weapon for several years. They have managed to put the monkey on your back in that Korean show. You had no more capability for this operation than my grandmother. It is one of the most diabolical propaganda achievements since the curtain went up on this business and they have sold it and it sticks yet.

From my information, this other side is loaded in all areas. I want to emphasize particularly in the biological. We know about his chemical potential. He has in the field with troops and modern hardware operational, well-trained troops, excellent decontamination units in the field in Germany now and in the satellites. It is an appalling condition, shocking condition.

What we are confronted with is a question of national policy, the state of mind, the concept, the belief, the attitude of the American people and perhaps of the civilized Western World about this kind of warfare.

This is not the kind of thing you can go out and engage in an educational campaign to justify your program. You cannot go to the high schools and colleges and newspapers and the League of Women Voters and the chambers of commerce all over the United States with this program and say that we have to have a big CBR program.

General STUBBS. No, sir.

Mr. FLOOD. This is the nub of this thing. What is he going to do?

Mr. SIKES. Will the gentleman yield?

Mr. FLOOD. Yes.

PUBLIC INFORMATION ON CBR

Mr. SIKES. Mr. Flood is touching on something which is extremely important, and that is the need for more information on CBR to be available to the public. You have been pretty well circumscribed in telling the public what this subject is all about. What can be done in the way of a bona fide educational program to let the public know the facts of life on CBR?

General STUBBS. Well, sir, we have developed a plan to inform the people of the United States and the free world of the threat they face. It is not an information program, I am sure you read in the newspapers we are accused of writing a campaign for more funds by informing the people and scaring the people of the United States.

Mr. SIKES. If it were true, you would not be the first.

Mr. FLOOD. May I point out this is the fantastic dilemma in which this man finds himself.

Mr. SIKES. Let us get the answer.

Mr. FLOOD. He has no answer. Or has he?

General STUBBS. Yes, sir; I will try to give you one. I feel Civil Defense has a major part of this operation to inform the public.

CIVIL DEFENSE

Mr. FLOOD. Civil Defense?

General STUBBS. They have to take care of the people of this United States.

Mr. FLOOD. They are in worse shape than you are. They are not even respectable in Pentagon circles.

Mr. SIKES. Let me ask this question, if you will yield again. What is being done in Russia to tell their people about CBR? Are they being kept in ignorance about it or do they know about it and know about the defense for CBR?

General STUBBS. Their people are well instructed, their civil defense posters are good and used throughout Russia in their program. Some 30 million of them are reported to us as having gone through their civil defense training program. This has gone to the outlying communities.

Mr. SIKES. This is civilian as well as military?

General STUBBS. The civilian defense program is directed at civilians, not military.

Mr. MAHON. May I interrupt? I do not want to be arbitrary, but nobody on my left will have any time to question the witnesses unless I yield to them now. Without objection, I want to yield to the members on this side.

Mr. FLOOD. Well, there is objection. This is an appallingly important subject. We are putting 4 months on ICBM's and 2 hours on an operation which can wash out, and the chances are you can get some great arguments about this at high staff levels in foreign countries as to what is going to be the war. Go ahead. There are a lot of things I would like to say about it.

Mr. MAHON. Are there any questions on my left?

Mr. FORD. Mr. Chairman, I have interrupted others on the committee, and I have no further questions at this time.

Mr. WEAVER. No questions.

Mr. MINSHALL. No questions.

PRODUCTION COSTS

Mr. FORD. I apologize. Let me ask this. We have seen your funding programs, General Stubbs, for the R. & D. over a period through fiscal 1965. What do you envisage as your production program cost for the same time period on an annual basis?

General STUBBS. We have made an estimate. We estimate ——— for the Army from 1960 to 1965.

Mr. FORD. Over the the full time period?

General STUBBS. Yes, sir. We have attempted to forecast what comes out, what is it that is required. This does require searching.

Mr. FORD. If this program is funded, it will provide the capability that you believe necessary for our Armed Forces at the end of that time to be fully competent in this area?

General STUBBS. Yes, sir; that was the basis for this.

BUDGET REQUEST

Mr. SIKES. I would like to ask this question. Talking about the 1961 budget, how much has been included in this budget as opposed to what you had requested in this budget? If necessary, give us a breakdown on the major items of difference. You can provide that for the record.

General STUBBS. Yes, sir. I will provide that specifically.

(The information requested follows:)

Chemical Corps appropriation summary fiscal year 1961

[In millions]

	Estimated Chemical Corps programs as proposed by Chemical Corps	Amounts approved in fiscal year 1961 President's budget
R.D.T. & E., A	55.3	55.3
PEMA	53.7	53.7
O. & M., A	25.5	24.8

Tentative amounts provided by DCSLOG and Chief, Research and Development to Chemical Corps reflects a satisfactory balance between R.D.T. & E., A and PEMA programs. However, a potential imbalance exists at present in O. & M., A in relationship to these programs.

General STUBBS. I would like to make this comment. The information Dr. Summerson presented here on the R.D.T. & E. program has not only been to meet Army requirements, this has gone through Mr. Morse, General Trudeau, it has been discussed with Dr. York and Dr. Willcox.

I would like to say at this time that General Lemnitzer, General Trudeau, General Colglazier, and the Army civilian secretaries are also recognizing and supporting this program to the extent possible with the resources available to them. We are getting the assistance to get going as rapidly as possible.

AIR DELIVERY

Mr. FLOOD. What are you doing with the weather people on air currents for dissemination of any of your ammunition? Are you using air currents, weather conditions, rain, air? What happened to this thing? Do we not have a program for utilization of air currents and storm clouds?

General STUBBS. Yes, we do. Our program is primarily antipersonnel.

Mr. FLOOD. Regardless of what? Since you tell me that is all we are going to have, it must be that.

General STUBBS. We will maximize use of air currents and maximize use of delivery over target. I have to explain myself. As time goes along, the ability for this material to go farther downwind and be effective is going to become greater.

Mr. FLOOD. You are examining prevailing air currents?

General STUBBS. Yes, sir; that is what we call our——

Mr. FLOOD. I have in mind the World War II Japanese fire balloons.

General STUBBS. We are looking into all of the ways that we can utilize the elements to our benefit to distribute these materials.

Of course, as we do this we feel the Russians have done just as well as we have probably.

(Discussion off the record.)

SABOTAGE

Mr. FLOOD. Has the sabotage element been examined any further than it was years ago?

General STUBBS. Against us?

Mr. FLOOD. Both ways. As far as you are concerned, of course, your way.

General STUBBS. I would say, yes, but then I do not know that any greatly different conclusions from those previously arrived at have come out, sir. It is tremendously effective and all we need is a few people. All they need is a few people to cause a tremendous amount of effect.

Mr. FLOOD. Some of my friends here, in the best American tradition, suggest we refer to this gap as the bug gap as distinguished from the missile gap.

DISARMAMENT

Mr. MAHON. General, I would like to make an observation and ask one question. A great deal has been printed in the papers recently

in regard to resumption of disarmament talks. In the past people have talked of wars and rumors of wars and have generally felt that war was unfortunate but that there was nothing too final about war since only relatively few people lose their lives and the world would go on much as it had with progress through the years taking place.

Now with the atomic weapons, war cannot be looked upon as it has been looked upon for thousands of years. There is a decisiveness and finality to war which was not in the picture prior to the advent of the atomic bomb.

In my judgment, the pressures will be very great for some disarmament program in the next decade or so. I have never had much faith in this kind of thing in the past, but I rather suspect something may eventuate as a result of the present situation. It seems to me that probably through a process of inspection we could have an effective disarmament program insofar as ballistic missiles are concerned.

I would like to know whether or not in this area of warfare which we have been discussing there would be the possibility of having an effective disarmament program and agreement among the nations which might reasonably be expected to be effective. Have you ever thought about that?

General STUBBS. Yes, sir, very much. I must divide my answer into two parts to show my reasoning here.

In the making of the agents, that is, the materials themselves, I do not see that there is any possibility of running a control on it, sir. That is, a control of that which is necessary to make a biological agent. BW agents can be made in very simple apparatus. While in our plants, we provide ultimate safety and that makes our equipment expensive. When this is not a factor, these materials can be made rather cheaply.

I would say that the probability of being able to assure that we do not have a biological production facility, say, even in the Washington area is very low I would not want to be charged with the responsibility for determining if only two or three people were making the material in the Washington area. If I were the inspector, I would have to have an awful large force to find these few people. I repeat, I think the probability here is very small.

When it comes to delivery, if it is a missile that is the delivery means, this falls into the same category as the other weapons regardless of whatever you are delivering. There is this additional aspect about the chemical and biological weapons, however. That is, they can be delivered covertly into a community, by very, very little makeshift means such as for example, carrying it in their suitcases.

Mr. MAHON. Do you seek to leave with me the impression that an international agreement in this field, including the best possible inspection, would probably be futile?

General STUBBS. That is correct, sir.

Mr. SHEPPARD. Will the gentleman yield?

Mr. MAHON. Yes.

Mr. SHEPPARD. In other words, as I interpret your reaction to the chairman's question, you have two facets here of international concept. One is a recognized military devastating area. Yet here comes this operation, which could be very, very definitely applied in

an economic war without being within the category of a declaration of war.

General STUBBS. This I feel is true, sir.

Mr. FLOOD. What a chance for a beautiful one-act play. It used to be said 200 or 300 years ago that he who controlled Paris controlled France. From now on they better be sure that the two- or three-star general who controls this CBR business is very loyal to the Government.

POTENTIAL FOR INDIVIDUAL CAPABILITY

Mr. MAHON. What about the individual scientists internationally? Are we not giving every man more or less an opportunity to be as dangerous as an atomic bomb?

Dr. GOODLOW. Give me my wife's kitchen and the Flit gun and I can do a lot of damage, as that kitchen is equipped right now, and your kitchen.

Mr. FORD. Without great expenditure?

Dr. GOODLOW. I would not have to spend a cent.

Mr. SHEPPARD. How much devastation cropwise could one person disseminate within the continental United States under the free world concept and no war?

Dr. GOODLOW. All they would have to do is take an ordinary automobile and disseminate the stuff from the tailpiece, right along the road and get the job started, and it will take off by itself—very simple.

Mr. FLOOD. Imagine throwing a can of this into the ventilating system.

Mr. WEAVER. It would be possible, for example, for a small country to build up a sizable force and unleash it against our country; is that right?

Dr. GOODLOW. Let me say this off the record.

(Discussion off the record.)

Mr. MAHON. Are there any further questions? If not, thank you very much, gentleman, for a very provocative presentation.

STEPS TO ACHIEVE GREATER ECONOMY AND EFFICIENCY

Mr. FORD. Mr. Chairman, it has been the policy of the committee each year to have a submission by the Army on the steps taken by the Army to achieve greater economy and efficiency. They have prepared this document. I suggest it be included in the record.

Mr. MAHON. I think it would be good, if there is no objection, to include it in the record. However, we ought to make a place for it where it would be pertinent and where it would come to the attention of people who are interested in our hearings. I think we can leave that up to the staff to work that out.

Mr. FORD. It probably should be in the Procurement Section.

Mr. MAHON. I think so. I thought we put something in for the services.

General TRAUB. Not this year, sir. The actual compilation Mr. Ford holds was not available to me until now.

(The document referred to will be found beginning on page 801 of volume V of these hearings.)

WEDNESDAY, MARCH 16, 1960.

RESEARCH, DEVELOPMENT, TEST, AND EVALUATION, NAVY

WITNESSES

HON. JAMES H. WAKELIN, JR., ASSISTANT SECRETARY OF THE NAVY (RESEARCH AND DEVELOPMENT)

VICE ADM. J. T. HAYWARD, USN, DEPUTY CHIEF OF NAVAL OPERATIONS (DEVELOPMENT)

REAR ADM. R. BENNETT, USN, CHIEF OF NAVAL RESEARCH

REAR ADM. H. A. YEAGER, USN, ASW READINESS EXECUTIVE

REAR ADM. K. S. MASTERSON, USN, DIRECTOR, GUIDED MISSILES DIVISION, OPNAV

REAR ADM. R. L. MOORE, JR., USN, DEPUTY AND ASSISTANT CHIEF OF BUREAU OF SHIPS

REAR ADM. C. B. GALLOWAY (MC), USN, ASSISTANT CHIEF, BUREAU OF MEDICINE AND SURGERY (RESEARCH AND MILITARY MEDICAL SPECIALTIES)

BRIG. GEN. BRUNO A. HOCHMUTH, USMC, DEPUTY CHIEF OF STAFF (R. & D.), HQMC

R. C. WARSING, COMPTROLLER, OFFICE OF NAVAL RESEARCH

CAPT. E. J. FAHY, USN, ASSISTANT CHIEF, BUREAU OF SHIPS (R. & D.)

CAPT. COOPER B. BRIGHT, USN, OFFICE OF DEPUTY CHIEF OF NAVAL OPERATIONS (LOGISTICS)

REAR ADM. G. F. BEARDSLEY, USN, DEPUTY COMPTROLLER OF THE NAVY

REAR ADM. LOT ENSEY, USN, ASSISTANT COMPTROLLER, DIRECTOR OF BUDGET AND REPORTS

Program and financing

	1959 actual	1960 estimate	1961 estimate
Program by activities:			
Direct obligations:			
1. Military sciences	$105,534,614	$135,116,500	$123,400,000
2. Aircraft and related equipment	91,512,476	95,705,300	96,800,000
3. Missiles and related equipment	628,266,859	685,520,577	668,500,000
4. Military astronautics and related equipment			1,300,000
5. Ships and small craft and related equipment	161,045,797	163,475,100	151,300,000
6. Ordnance, combat vehicles, and related equipment	70,359,452	76,194,523	75,600,000
7. Other equipment	47,055,872	51,387,000	45,100,000
8. Programwide management and support	43,247,557	43,740,000	45,500,000
Total direct obligations	1,147,022,627	1,251,139,000	1,207,500,000
Reimbursable obligations:			
1. Military sciences	6,411,665	7,940,000	8,010,000
2. Aircraft and related equipment	349,626	524,000	524,000
3. Missiles and related equipment	5,284,587	6,352,000	6,352,000
5. Ships and small craft and related equipment	2,218,980	5,089,000	3,493,000
6. Ordnance, combat vehicles, and related equipment	3,206,525	3,650,000	3,650,000
7. Other equipment	697,928	830,000	760,000
8. Program-wide management and support	738,291	844,000	844,000
Total reimbursable obligations	18,907,602	25,229,000	23,633,000
Subtotal	1,165,930,229	1,276,368,000	1,231,133,000
Less intrafund obligations		163,000	263,000
Total obligations	1,165,930,229	1,276,205,000	1,230,870,000

DEPARTMENT OF THE NAVY—RESEARCH, DEVELOPMENT, TEST, AND EVALUATION, NAVY—Continued

Program and financing—Continued

	1959 actual	1960 estimate	1961 estimate
Financing:			
Comparative transfers from (−) other accounts	−$311,397,934	−$256,561,000	
Unobligated balance brought forward	−10,228,978	−44,975,453	−$65,250,530
Unobligated balances transferred (73 Stat. 377) from "Procurement of ordnance and ammunition, Navy"		−4,433,077	
Advances and reimbursements from—			
Other accounts	−18,668,278	−24,646,000	−22,950,000
Non-Federal sources (10 U.S.C. 2481)	−422,942	−420,000	−420,000
Unobligated balance carried forward	44,975,453	65,250,530	26,750,530
New obligational authority	870,187,550	1,010,420,000	1,169,000,000
New obligational authority:			
Appropriation	830,779,300	1,015,920,000	1,169,000,000
Transferred to "Emergency fund, Department of Defense" (73 Stat. 377)		−5,500,000	
Transferred from "Emergency fund, Department of Defense" (70 Stat. 456; 71 Stat. 313)	39,408,250		
Appropriation (adjusted)	870,187,550	1,010,420,000	1,169,000,000

Object classification

	1959 actual	1960 estimate	1961 estimate
RESEARCH, DEVELOPMENT, TEST, AND EVALUATION, NAVY			
Total number of permanent positions	$24,338	$24,870	$24,685
Full-time equivalent of all other positions	19	21	21
Average number of all employees	23,137	23,408	23,557
Number of employees at end of year	23,418	24,302	24,228
Average GS grade and salary	9.0 $7,285	9.1 $7,338	9.1 $7,352
Average salary of ungraded positions	$5,518	$5,566	$5,585
Personal service obligations:			
Permanent positions	$140,927,635	$143,501,106	$144,820,000
Positions other than permanent	150,943	147,052	147,000
Other personal services	5,079,558	5,899,042	5,334,000
Total personal service obligations	146,158,136	149,547,200	150,301,000
Direct obligations:			
01 Personal services	140,308,244	142,542,200	144,397,000
02 Travel	4,555,909	4,618,690	4,706,000
03 Transportation of things	265,509	199,015	199,000
04 Communication services	1,116,773	1,174,200	1,179,000
05 Rents and utility services	5,624,351	5,839,000	5,822,000
06 Printing and reproduction	357,339	377,070	400,000
07 Other contractual services	780,108,903	811,062,384	775,446,000
Services performed by other agencies	2,157,919	2,744,000	2,895,000
08 Supplies and materials	99,924,673	100,653,871	100,466,000
09 Equipment	104,054,587	174,107,121	164,624,000
10 Lands and structures	47,000	30,000	30,000
11 Grants, subsidies, and contributions	8,440,445	8,792,550	8,873,000
15 Taxes and assessments	57,693	61,914	64,000
Subtotal	1,147,019,345	1,252,202,005	1,209,101,000
Deduct portion of foregoing obligations originally charged to object class 07		1,084,000	1,601,000
Total direct obligations	1,147,019,345	1,251,118,005	1,207,500,000
Reimbursable obligations:			
01 Personal services	5,849,892	7,005,000	5,904,000
02 Travel	104,581	115,000	115,000
03 Transportation of things	500	1,000	1,000
04 Communication services	28,500	29,500	29,000
05 Rents and utility services	793,573	970,000	968,000
06 Printing and reproduction	28,900	29,000	29,000
07 Other contractual services	8,491,585	12,755,800	12,339,000
08 Supplies and materials	802,112	833,000	833,000
09 Equipment	2,475,169	3,035,000	3,031,000
10 Lands and structures	600	1,000	1,000
11 Grants, subsidies and contributions	331,690	452,700	382,000
15 Taxes and assessments	500	1,000	1,000
Total reimbursable obligations	18,907,602	25,229,000	23,633,000
Subtotal	1,165,926,947	1,276,347,005	1,231,133,000

JUSTIFICATION OF THE ESTIMATE

Mr. MAHON. We shall place in the record at this point the appropriate pages of the justifications.

(The justifications follow:)

Appropriation introduction

	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961
Total direct obligations	$1,147,022,627	$1,251,139,000	$1,207,500,000
Net adjustments	−276,835,077	−240,719,000	−38,500,000
Appropriation or estimate	870,187,550	1,010,420,000	1,169,000,000

The fiscal year 1961 Navy research, development, test, and evaluation program is based on a careful analysis of requirements to meet the needs of the Department of the Navy. It is a balanced, integrated program which represents the most carefully planned and continuing effort, consistent with the Federal budget and policy, to develop, test, and evaluate the next generation of weapon and support systems. These systems, together with the program of basic and supporting research, have been planned to fulfill the Navy's objectives for fiscal year 1961. The program is predicated on the requirements of the Chief of Naval Operations and the Commandant of the Marine Corps, supplemented by the planned efforts of the Chief of Naval Research and the Bureau Chiefs to fulfill these requirements in their assigned fields of responsibility. The total fiscal year 1961 request of $1,169 million includes $222 million for major test and evaluation items previously funded by the procurement appropriations.

The research and development program of the Navy is broad in scope since it must provide for increased combat capability for the immediate future, encompass the learning work that is essential to future progress, and also seek ways for improving the effectiveness of day-to-day operations. It must also support all operational missions of the Navy: in the air, on the sea, and beneath the sea. It must provide weapons and supporting systems that will allow command to shift rapidly from offense to defense, provide for optimum tactical maneuvering, adjust to change of pace, and provide accurate information to enhance the correctness of command decisions. Hence, this program is a combination of research, technique studies, development, and engineering improvement. It is keyed to the national objective of controlling the seas both as lanes of communications and as the base from which to launch offensive strikes against the enemy.

The responsibility for policy, management and control of the Navy research and development program is vested in the Assistant Secretary of the Navy (Research and Development). The Assistant Secretary of the Navy (Research and Development) is aided in carrying out this responsibility by the Deputy Chief of Naval Operations (Development) and the Chief of Naval Research. The Deputy Chief of Naval Operations (Development) establishes the military requirements or desired end objectives of the program, reviews the progress of the program toward accomplishing such objectives, and coordinates the development phase of the program. The Chief of Naval Research is the adviser to the Assistant Secretary of the Navy (Research and Development) on all research matters and is specifically responsible for the Navy's research program. It is the responsibility of the Chief of Naval Research to insure that the research program is scientifically and technically feasible, economically practical, and is directed toward the ultimate attainment of basic military objectives in the shortest practicable time. In these review activities the staffs of both the Deputy Chief of Naval Operations (Development) and the Chief of Naval Research strive to assess the increases in combat capability that can be attained through new material, methods, and techniques and to guide the development activities into the most promising avenues.

This appropriation provides for the cost of the research, development, test, and evaluation program conducted by the seven bureaus and offices of the Navy and the Marine Corps. Since the number of research areas in which the Navy is interested is extremely large, simply by virtue of the technological require-

ments of our defense and the mediums in which we operate, a variety of organizations, facilities, and skills, must be employed to carry on the research and development program. This program is carried on at naval and Department of Defense laboratories, other Government laboratories, and through a contractual program with industrial and commercial laboratories, with universities, and with nonprofit laboratories and institutions. It is the policy of the Navy to have its research and development work performed in that location best qualified to do the work. Careful consideration is always given to the competence of the scientific investigator and to the facilities available for the research. Many research programs require scientific capabilities and facilities available only in the specially staffed and equipped laboratories of the Navy. The contract work consists of both small, individually conducted research projects and large-scale projects where teams with capabilities in specialized fields have been built up. Through the contract program, leading scientists throughout the country are supported in research programs in areas of science important to the Navy; thus, the Navy obtains the collaboration of the entire scientific community and is in a position to exploit new scientific results as soon as they are obtained.

The estimates for fiscal year 1961 are based on detailed listings of research, development, test, and evaluation projects and represent the most equitable distribution of funds between research and development projects.

While it is not possible to determine at the time budgets are prepared the amounts that will be carried forward into succeeding fiscal years, it is known that two major conditions leading to the carrying forward of unobligated balances will exist.

(a) The existence on June 30 of each year of an unknown number of approved research and development projects for which contract negotiations will not have been satisfactorily completed. Past experience has proven that in many cases the best interests of the Government will be served by permitting negotiations to extend past the fiscal year ending date. The ability to do this represents one of the primary advantages to the Government of the no-year type appropriations.

(b) A large portion of the research and development funds of the Navy is distributed throughout the entire Navy field research and development establishment in the form of individual allotments. Each such allotment represents an absolute maximum and may not be exceeded. Consequently, each such allotment will have as a safety factor, a balance of funds remaining, the total of which is unknown but can be estimated on the basis of past experience.

The anticipated unobligated balances to be carried forward each fiscal year are indicated in the following table which sets forth the total funding requirements under the appropriation "Research, development, test, and evaluation, Navy."

	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961
Total comparative new obligational authority	$1,174,309,649	$1,256,725,000	$1,169,000,000
Less adjustment for comparative transfer of NOA	−304,122,099	−246,305,000	
Total NOA in Budget Document	870,187,550	1,010,420,000	1,169,000,000
Add prior year carryover into current year (net of unobligated reimbursements)	+6,967,199	+41,530,056	+61,805,133
Unobligated balance transferred from other accounts		+4,433,077	
Total availability	877,154,749	1,056,383,133	1,230,805,133
Deduct carryover into subsequent years (net of unobligated reimbursements)	−41,530,056	−61,805,133	−23,305,133
Total direct obligations	835,624,693	994,578,000	1,207,500,000
Add comparative transfer of obligations	+311,397,934	+256,561,000	
Total direct obligations in budget document	1,147,022,627	1,251,139,000	1,207,500,000

JUSTIFICATION OF ESTIMATES FOR FISCAL YEAR 1961

Summary of comparative new obligational authority

Budget activity No.	Budget activity	1959 actual	1960 estimate	1961 estimate	Difference 1961 compared with 1960
1	Military sciences	$132,492,610	$122,771,000	$113,389,000	−$9,382,000
2	Aircraft and related equipment	92,726,826	92,769,000	98,129,000	+5,360,000
3	Missiles and related equipment	633,183,494	694,535,000	658,203,000	−36,332,000
4	Military astronautics and related equipment			1,272,000	+1,272,000
5	Ships and small craft and related equipment	163,027,000	174,526,600	138,834,000	−35,692,600
6	Ordnance, combat vehicles, and related equipment	70,940,221	74,688,000	70,949,000	−3,739,000
7	Other equipment	36,365,444	52,552,000	42,699,000	−9,853,000
8	Programwide management and support	45,574,054	44,883,400	45,525,000	+641,600
	Total comparative new obligational authority	1,174,309,649	1,256,725,000	1,169,000,000	−87,725,000
	Net adjustment for comparative transfers	−304,122,099	−246,305,000		+246,305,000
	Total new obligational authority in budget document	870,187,550	1,010,420,000	1,169,000,000	+158,580,000

	1959 actual	1960 estimate	1961 estimate	Difference 1961 compared with 1960
Less: Obligations to be incurred in subsequent years	$38,201,742	$61,804,712	$23,304,712	−$38,500,000
Obligations against current-year funds	831,985,808	948,615,288	1,145,695,288	+197,080,000
Add:				
Obligations against prior-year authority	3,638,885	41,529,635	61,804,712	+20,275,077
Obligations against authority transferred from other accounts		4,433,077		−4,433,077
Comparative transfer of obligations in budget document	311,397,934	256,561,000		−256,561,000
Total direct obligations in budget document	1,147,022,627	1,251,139,000	1,207,500,000	−43,639,000

The previous tables show the distribution of this appropriation on the standardized Department of Defense functional category basis. The following tables and the justifications present the appropriation in the manner in which the Navy administers it, i.e., by naval organization. Each of the Navy bureaus and the Marine Corps have been assigned a precise segment of the Navy's total operational mission and is held responsible for its effective conduct including the conduct of research, development, test, and evaluation projects to satisfy the particular requirements of its functional task.

Summary of comparative new obligational authority—classification for purposes of justification and administration

Budget activity No.	Budget activity	1959 actual	1960 estimate	1961 estimate	Difference 1961 compared with 1960
A	Office of Naval Research	$109,121,177	$99,030,500	$92,162,000	−$6,868,500
B	Bureau of Naval Weapons	877,842,328	948,393,900	902,286,000	−46,107,900
C	Bureau of Ships	168,476,582	181,630,600	143,973,000	−37,657,600
D	Bureau of Medicine and Surgery	4,793,700	4,802,000	5,309,000	+507,000
E	Bureau of Yards and Docks	3,808,000	3,983,000	4,093,000	+110,000
F	Bureau of Supplies and Accounts	2,264,000	2,180,000	2,140,000	−40,000
G	Bureau of Naval Personnel	764,000	800,000	1,008,000	+208,000
H	Marine Corps	7,239,862	15,905,000	18,029,000	+2,124,000
	Total comparative new obligational authority	1,174,309,649	1,256,725,000	1,169,000,000	−87,725,000
	Net adjustments for comparative transfer	−304,122,099	−246,305,000		+246,305,000
	Total new obligational authority in budget document	870,187,550	1,010,420,000	1,169,000,000	+158,580,000

	1959 actual	1960 estimate	1961 estimate	Difference 1961 compared with 1960
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Obligations against current year funds	831,985,808	948,615,288	1,145,695,288	+197,080,000
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Obligations against prior-year authority	3,638,885	41,529,635	61,804,712	+20,275,077
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Comparative transfer of obligations in budget document	311,397,934	256,561,000		−256,561,000
Total direct obligations in budget document	1,147,022,627	1,251,139,000	1,207,500,000	−43,639,000

EXPLANATION OF INCREASES AND DECREASES, FISCAL YEAR 1961 COMPARED WITH FISCAL YEAR 1960

Budget activity No. A: Office of Naval Research

1A. *Military sciences.*—The decrease of $6,838,000 is a net decrease resulting from decreases in various projects partially offset by increases in other projects. The major decreases are in fields such as sonar, metals and alloys, electronics and contractor laboratories and are partially offset by increases in oceanography (including FBM oceanography), FBM system research, FBM sub propulsion, and astronautic-celestial charting and prediction. A large share of the reduction in fiscal year 1961 stems from the fact that most of a major research facility for underwater sound investigations will be completed with fiscal year 1960 funds.

2A. *Aircraft and related equipment.*—The decrease of $2,199,000 in this budget project results primarily from a reduction in aircraft instrumentation. The effort on revolutionary improvement in aircraft instrumentation, now concerned with perfecting and adapting it for incorporation into the next generation of high performance aircraft, will continue, but will not be quite so protracted in 1961. A reduction in training devices accounts for the remainder of the decrease.

3A. *Missiles and related equipment.*—The increase of $1,269,000 will permit the Naval Research Laboratory to engage in advanced exploration and analyses of potential future Fleet Ballistic Missile and related support systems. With the operational realization of the first generation POLARIS forging ahead on a tight development schedule at high priority, it is necessary to identify and close the scientific and technological gaps which—if left unattended—would stand in the way of the timely and economical development of followon systems that capitalize on the growth potential of this concept.

5A. *Ships and small craft and related equipment.*—The increase of $503,000 is requested primarily for areas directed toward far-reaching simplifications of submarine and surface ship operation. An increase in training devices is also requested.

7A. *Other equipment.*—The major portion of the $655,000 increase is requested for mastery of techniques and accumulation of data aimed at the establishment of an environmental prediction system required for antisubmarine warfare purposes and covering geophysical-geographic and oceanographic-hydrographic aspects. Increases are also requested for mine defense and airborne antisubmarine warfare projects.

8A. *Programwide management and support.*—The decrease of $258,500 in this budget project is due to a reduction in the plant property procurement of the Naval Research Laboratory.

Mr. MAHON. This morning we will begin our hearing on the research and development requirements of the Navy for the fiscal year 1961. We are pleased to have the new Assistant Secretary of the Navy for Research and Development, Mr. Wakelin, with us this morning. I understand your mother has been injured and will probably be operated on later today, so we are going to suggest that you leave the reading of your statement to someone else who is present here this morning.

We have already explored the research and development budget of the Army and we have talked at length with Dr. York. We will want to go into the details insofar as we can of the Navy research and development budget.

VALIDITY OF RESEARCH AND DEVELOPMENT

There has been a persistent feeling over a long period of time that the military services and other branches of the Government probably secure money for research and development for purposes which are really not warranted. All of us know that everyone is for progress and we believe in research and development and, in our enthusiasm to promote progress through research and development, the sky seems to be the limit. Research and development dollars are not hard to come by, as everyone knows.

Under those circumstances it seems to me to be the duty of the committee to try to explore the validity of various projects. There was a time, in my opinion, when there were quite a number of research projects which could hardly be justified. Possibly that situation does not exist to any substantial degree at this time. I hope it does not exist at all.

We certainly want to provide all the funds that are necessary. I am by no means convinced that we have a sufficiently ambitious program in any of the services for research and development. It may be that we ought to be doing much more in certain fields.

My point is, since this is such a highly vital and important field, let us spend all the money necessary and all the energy and resources necessary, but let us spend this energy and money on projects that really contribute to the security of the country. For example, I am afraid a lot of the NIKE-ZEUS money may prove to be, in hindsight, money down the drain, but I do not think one has to apologize for doing everything in his power to try to find a defense against the intercontinental ballistic missile. That is big league and I think our major effort should be placed in the big league areas. Of course, it

is not always possible to be assured that this or that program is in the big league area. A program might turn out to be highly important when it did not give promise of being significant and important.

What is your general feeling in regard to this expression on my part, Admiral?

NEW APPROPRIATION STRUCTURE

Admiral HAYWARD. I feel that some of the picture in research and development has been colored by some of the manipulation of moneys in the test and evaluation part of the appropriation, Mr. Chairman. Several years ago when we came before you it was very easy to break out the research and development part of the program. But at the request of this committee, really, and the Congress, there was a feeling that a lot of work was going on in R. & D. that was not covered; so they put this term "test and evaluation" in. It was a valid thing to do because until the thing became operational you really had not finished the development.

Mr. MAHON. If I may interrupt, there again, perhaps there was a bit of psychology involved in that Congress wanted to show to the fullest extent what was actually being done in research and development and probably the Defense Department wanted to do the same thing.

Admiral HAYWARD. Yes, sir, this is correct, and it was very valid. Now you see when you look at these large sums, you immediately think that this had been going on a long time. The idea that research and development moneys were always easy to come by and are easy to come by I do not think is valid; no, sir. I feel that we have not done a lot of the work that we should have done in the period of about 1950 to 1956 or from 1945 to 1956. You are paying the price of that now. In order to really go forward, you are going to have to pay that price for a good many years.

By that neglect the cost has gone up, no question in my mind, on things we did not do. We have many valid proposals that have direct application to our business which we are not able, really, to fund.

Mr. MAHON. Do you mean to imply that we must be careful not to delude ourselves into thinking we are doing more in research and development than we actually are doing? In other words, as a result of this new policy of lumping all these expenditures we might get a distorted picture and lead ourselves or others into believing we have a more ambitious program than we really have?

Admiral HAYWARD. That is right. I think that can be a very serious thing when you start putting the price of missiles, which run very high, as you know, into the R.D.T. & E.—and it is valid, do not get me wrong; it is valid because that is part of our effort to get an operational missile—the definition that it is in R.D.T. & E. until it is delivered as hardware to operating forces is sound, but this is what has made this number look astronomical. It really is not. We can delude ourselves.

For instance, 3 years ago when we came before this committee, our R. & D. effort was in the neighborhood of $525 million. Now today in 1961 the budget is $1,169 million, but a great portion of that is T. & E. The basic effort has not varied.

Mr. MAHON. If you should go back and recalculate the budget for 3 years ago on the basis of present calculation, that figure would come up.

Admiral HAYWARD. Yes, sir, it would very definitely come up.

Mr. MAHON. Then you would get a truer picture by comparison.

Admiral HAYWARD. That is correct.

Mr. MAHON. I think we will want to discuss with you what perhaps we should be doing that we are not doing and what the validity of the direction of the program really is, but before we do that I think we should proceed with the Secretary's statement and then with other statements to be presented. Will you proceed.

GENERAL STATEMENT OF ASSISTANT SECRETARY OF THE NAVY FOR RESEARCH AND DEVELOPMENT

QUALIFICATIONS AND BACKGROUND OF WITNESS

Name and title of witness: Dr. James H. Wakelin, Jr., Assistant Secretary of the Navy (Research and Development).

A.B., 1932, Dartmouth College, in physics.

B.A., 1934, Cambridge University, Cambridge, England, in natural sciences.

M.A., 1939, Cambridge University, Cambridge, England, in natural sciences.

Ph. D., 1940, Yale University in physics.

1939–43, senior physicist, Physical Research Department, B.F. Goodrich Co., Akron, Ohio. 1943–45, Ordnance staff officer to the Coordinator of Research and Development, Navy Department. 1945–46, lieutenant commander, USNR, served as head of the Chemistry, Mathematics, and Mechanics and Materials Section of the Planning Division, Office of Research and Inventions, and was active in the planning and organization of the Navy's program to sponsor basic scientific research, now under the direction of the Office of Naval Research.

Following World War II, joined a group of former Navy scientists in the establishment of Engineering Research Associates, Inc., of Washington, D.C., and St. Paul, Minn., and held the position of Director of Research. During this period, was also Director of Field Survey Group of ONR Project Squid under contract to Princeton University. In 1948, became associate director of research of the Textile Research Institute in Princeton. In June 1951, appointed director of Research of the Institute, serving in this capacity for 3 years. In 1954, established own consulting business in Princeton, and has been consultant on research planning and organization to the Lamp Division, General Electric Co., Cleveland, Ohio; Stanford Research Institute, Palo Alto, Calif.; American Radiator & Standard Sanitary Corp., New York City; J. P. Stevens & Co., Inc., New York City; Frenchtown Porcelain Co. and Star Porcelain Co. of Trenton, N.J. One of the founders in 1954 of Chesapeake Instrument Corp., Shadyside, Md., established to conduct research and development for the Navy in the fields of underwater sound and acoustic devices, holding position as vice president and consultant of that company. During this period, also a research associate on the staff of Textile Research Institute working on the structure of physical properties of high polymers under a program sponsored by the Office of Naval Research.

Member of Sigma Xi, the American Physical Society, American Association for the Advancement of Science, the Association for Computing Machinery, the American Crystallographic Society, Textile Research Institute, the Textile Institute of Great Britain, and is a contributor of scientific papers to the Journal of Applied Physics, the Industrial and Engineering Chemistry and Textile Research Journal in the field of high polymer physics. Coauthor with C. B. Tompkins and W. W. Stifler, Jr., of "High-Speed Computing Devices" published by McGraw-Hill Book Co. in 1950.

Admiral HAYWARD (reading the statement of Mr. Wakelin):

"Mr. Chairman and members of the committee, it is an honor and a privilege for me to appear as Assistant Secretary of the Navy for

Research and Development before this committee for the first time to explain our fiscal year 1961 budget request. Since there have been significant changes in the Navy's research and development organization during the past year, I believe it appropriate at this point to explain these changes briefly.

"ORGANIZATION

"In the latter part of 1958, a board was established by the Secretary of the Navy to study the organization of the Navy Department and to make recommendations which would insure the maximum combat effectiveness and administrative efficiency of the Navy. The results of the study by this board, under the chairmanship of Mr. William B. Franke, now Secretary of the Navy, reaffirmed the desirability of the Navy's present bilinear organization with its definite division of military and nonmilitary duties and responsibilities among uniformed and civilian officials.

"As a result of the recommendations of the Franke Board, three major organizational changes were made which have a direct impact on the Navy's research, development, test, and evaluation program: an Assistant Secretary for Research and Development was appointed, a Deputy Chief of Naval Operations for Development was selected and the Bureaus of Aeronautics and Ordnance were merged to form the Bureau of Naval Weapons.

"As Assistant Secretary of the Navy for Research and Development, I am responsible for policy, management, and control of Navy Department research, development, test, and evaluation matters, including general management of the appropriation 'Research, development, test, and evaluation, Navy.' In the management of the Navy's research and development program, I maintain a close working relationship with the Director of Defense Research and Engineering, Dr. Herbert F. York, and members of his staff. I also meet with Dr. Joseph V. Charyk and Mr. Richard S. Morse, who are my counterparts in the Air Force and the Army, to discuss programs of mutual interest in order to coordinate our efforts in research and development matters.

"I also coordinate and direct the efforts of the bureaus and offices and the Headquarters, Marine Corps, in the fulfillment of research, development, test, and evaluation requirements of the operating forces. The Chief of Naval Research, Rear Admiral Bennett, is my adviser on research matters. Among other duties, the Chief of Naval Research has the responsibility for coordinating and integrating the research program of the Navy.

"The new Deputy Chief of Naval Operations for Development, Vice Admiral Hayward, is responsible for the coordination and issuance of Navy operational requirements for new weapons and equipments. In addition, the Deputy Chief of Naval Operations for Development coordinates and integrates the overall Department of the Navy research, development, test, and evaluation program for the Chief of Naval Operations in order to insure that the effort is continuously responsive to long-range objectives, operational requirements, fiscal limitations, and advancing technology. Admiral Hayward also advises me concerning the development program of the Navy.

"With the merger of the Bureaus of Aeronautics and Ordnance into the Bureau of Naval Weapons, approximately two-thirds of the total development effort of the Navy, including most of the weapon system development, is consolidated under one technical and procurement agency.

"The six bureaus (Bureau of Naval Weapons, Bureau of Ships, Bureau of Medicine and Surgery, Bureau of Yards and Docks, Bureau of Supplies and Accounts, and the Bureau of Naval Personnel), the Office of Naval Research and the Headquarters, Marine Corps, are the agencies which conduct the Navy's research, development, test, and evaluation and procure the weapons and equipments required by the operating forces of the Navy. The naval bureaus and offices, and the Headquarters, Marine Corps, are responsible for the accomplishment of precise segments of the total research, development, test, and evaluation program. For this reason, the budget justifications presented to this committee have been segregated first by bureau and office, and second by budget projects which conform to the established budget classification for the research, development, test, and evaluation appropriation title, such as 'Military sciences, aircraft and related equipment,' etc. After a few remarks on the research and development activities of the various bureaus and offices, I will briefly discuss our program under these budget categories.

"BUREAUS AND OFFICES

"The Office of Naval Research is the Navy's central research organization. Its research programs provide a broad foundation for advances in naval technology and operations. The research programs include hydrodynamics, oceanography, mathematics, physics, chemistry, metallurgy, and biology. The engineering fields include electronics, power sources, and underwater sound. Work is also being carried on in critical areas of naval warfare, such as antisubmarine and mine warfare.

"The Bureau of Naval Weapons research, development, test, and evaluation program translates known and projected fleet requirements into specific aircraft, missile, and antisubmarine weapon systems and associated equipments. Emphasis is continuing on naval missile systems designed for launching from surface ships, aircraft, and submarines.

"The Bureau of Ships continues to emphasize the effort in antisubmarine warfare and all of its related fields. Improved techniques and materials are being developed for use in detection, location, identification, and tracking of submarines. These improvements will lead to improved sonar transducers and receivers, more accurate shore direction finding and position fixing systems, and more effective communication and navigation systems. A major effort is underway to develop effective submarines capable of operating with reduced self-noise at increased speed and with increased capabilities for locating and destroying enemy submarines. A new deep water range which will be used for sound surveys is under development.

"The Marine Corps program will carry forward the development of a lightweight artillery weapon, an amphibious support vehicle, and other developments to provide the operating forces with the mod-

ern weapons, equipment and supplies required for amphibious assault operations.

"In the Bureau of Naval Personnel, efforts continue toward the improvement of selection, distribution, assignment, training, and personnel administration for both officer and enlisted personnel, and for the more effective matching of personnel to the machine complex that is the Navy.

"The Bureau of Yards and Docks contributes to the readiness of the Amphibious and SeaBee Forces. In the construction area, improvements are sought in the design, construction, and maintenance of shore facilities, including the capability of such structures to withstand the shock of enemy attack.

"The Bureau of Supplies and Accounts will operationally test and evaluate the results of recent advanced research in logistics, and will continue efforts to improve distribution, inventory management, and materials handling.

"The medical research program of the Bureau of Medicine and Surgery is designed to support the operating forces and to anticipate the biomedical demands and effects of new weapons systems. The introduction of the fleet ballistic missile system, POLARIS, will require research relative to physiological and toxicological problems of the closed environment of the nuclear powered submarine, which spends most of its time submerged. The increasing problems of health, action, and reaction in flight and in submarines, as well as under radiation hazards, are important phases of the Navy's medical research program.

"SCOPE OF THE PROGRAM

"As the members of this committee fully realize, the Navy's research and development program must encompass such broad areas as offensive and defensive operations with ships, submarines, aircraft and amphibious equipment. In our rapidly changing scientific and technical environment, we must pattern our program to cope with widely divergent threats in the future. With the present rate of progress in science and technology, a vigorous and diversified research and development program is essential in order to insure that the required weapons will be available to the Navy of the future.

"For our strike forces we are developing improved missiles, aircraft and aircraft weapons, with emphasis on improving our capabilities in non-nuclear or limited war.

"The Marine Corps, in its traditional role as a highly mobile, instantly ready attack force, requires a great variety of light and compact weapons.

"In the fields of underwater research and antisubmarine warfare, where the Navy is the principal service involved, there are many difficult problems associated with the development of weapons and surveillance systems to counter the submarine threat and the threat of submarine-launched missiles.

"The Navy's broad reesarch program is designed to emphasize many key areas, such as electronics, nuclear physics and nucleonics, the chemistry and physics of materials, the mechanics of fluids and structures, mathematics, data processing systems, upper atmosphere studies, oceanography, and the biological and psychological sciences.

Continued progress in these areas is mandatory to insure the effectiveness of the Navy of the future.

"In oceanography, for example, the Navy has established the TENOC plan, for 10 years of research in oceanography, and is playing a leading role in establishing a firm, coordinated national program. The goal of this coordinated effort is to double the scientific activity in the study of oceanography by 1970. Full cooperation has been achieved with the Departments of Commerce and Interior, the National Science Foundation and the Atomic Energy Commission through the Subcommittee on Oceanography of the Federal Council for Science and Technology. From my experience as chairman of this subcommittee, I feel that we will be able to achieve a substantial and orderly expansion of the national effort in the study of the oceans.

"OBJECTIVES OF FISCAL YEAR 1961 R. D. T. & E. PROGRAM

"The objectives of the fiscal year 1961 program are designed to insure adequate and properly directed support of our national interests. The principal objectives of this program are:

"Improved capabilities of our striking forces, including the fleet ballistic missile system, POLARIS.

"Increased ASW effectiveness.

"Increased air warfare effectiveness, especially in long-range detection and identification, tactical data processing and control of aircraft and missiles.

"Increased amphibious capability with emphasis on dispersed landing techniques and vertical envelopment operations.

"Exploitation of space technology for improvement of the Navy's combat capabilities.

"A continued broad and comprehensive program of basic and supporting research to provide for the Navy of the future.

"FISCAL YEAR 1961 R. D. T. & E. FUNDING

"Before discussing the dollar level of the fiscal year 1961 program, your attention is invited to the fact that there have been significant changes in the structure of the appropriation during the past 2 years. The support for test and evaluation of weapons and equipment has been shifted from other appropriations and the name of the appropriation has been changed from 'Research and development, Navy' to 'Research, development, test, and evaluation, Navy.' As a result, the amounts shown as new obligational authority in this budget for the fiscal years 1959 and 1960 have been adjusted for comparability with fiscal year 1961, and appear much higher than the actual appropriations for these 2 years. The Navy's request for $1.169 billion for new obligational authority for support of the fiscal year 1961 research, development, test and evaluation program includes $350 million for test and evaluation which represents about 30 percent of the total budget request.

"This request also includes $645 million for development work including all weapon system developments, which represents about 55 percent of the total program. There are major efforts planned to increase the Navy's capabilities in undersea warfare, strike warfare, amphibious warfare, and support warfare operations.

"Basic research is carried at a level of $58.6 million in this budget request, which represents about 5 percent of the program. The total of basic and applied research is $174 million, or approximately 15 percent of the program. These funding levels will allow us to continue our basic and applied research programs at a level of effort that is approximately the same as in fiscal year 1960. No major change is planned in the level of operation of Navy laboratories and test facilities.

"The fleet ballistic missile system, POLARIS, is the Navy's first priority program. The funds requested for POLARIS within the total R.D.T. & E. program is $374 million, which shows the impact of this important program on the overall research and development program of the Navy. The committee has already received a detailed presentation on this important weapon system.

"This committee has expressed a particular interest in the Navy's research and development program in antisubmarine warfare. A continued major emphasis will be placed on improving our antisubmarine warfare capability in fiscal year 1961. The priority of this program in the Navy is second only to that of the POLARIS system. Accelerated developments in the field of antisubmarine warfare are essential to improve our defenses against the ever-increasing threat of the Russian submarine. Our research and development program is designed to give our ASW forces the tools they require to meet and contain this threat.

"To insure that our ASW program is responsive to current and projected requirements, a new Navy Antisubmarine Warfare Committee has been established recently, with the Secretary of the Navy as Chairman. The Chief of Naval Operations is the Vice Chairman and members include the Under Secretary of the Navy, the Assistant Secretary of the Navy for Research and Development, the Deputy Chief of Naval Operations for Development, the Chief of Naval Research, the Chiefs of the Bureaus, and the heads of other key Navy Department offices. This Committee was established to provide top level review and direction of the Navy's total effort in antisubmarine warfare.

"The total amount requested for ASW in this budget is $180 million. This is essentially the same amount requested for fiscal year 1960; however, it is below the level finally approved by Congress for fiscal year 1960 since an additional $45 million was added by Congress for this most important effort.

"Now, with specific reference to the budget documents which have been provided to the Committee, I would like to describe briefly some of the major areas in the fiscal year 1961 R.D.T. & E. submission.

"MILITARY SCIENCES

"Although there are no weapon system developments under the military sciences category, the supporting research in this area contributes materially to our efforts in target surveillance, navigation, communications, and command control.

"Upper atmospheric research is progressing through the use of rockets and balloons. Probes with such rockets as the ARCAS, and manned and unmanned balloon flights are contributing a great deal of information concerning the nature of the earth's environment and

its surrounding medium. Data resulting from such programs will help to solve existing communication and navigation problems, as well as add to our basic store of knowledge.

"The Navy's program in medical research is helping man learn to live in new environments. Studies with the human centrifuge have added a wealth of information concerning the behavior characteristics of man under conditions of physical and mental stress. Other Government organizations are now cooperating in these programs.

"In the electronics supporting area, the Navy has strong research and development efforts directed toward the improvement of electronic components, particularly in reliability and integrity at high temperatures.

"Research in energy conversion is being pursued, including hydrogen fusion and thermoelectricity, for possible naval applications in the future.

"Research and development in the field of high temperature materials is continuing in order to insure the availability of the materials required for future naval weapons and equipments.

"AIRCRAFT AND RELATED EQUIPMENT

"In the aircraft and related equipment category, we are continuing the development of the drone ASW helicopter (DASH) concept, and are continuing with the design and development of the long-range missile fighter aircraft (MISSILEER) to carry the EAGLE missile system.

"The DASH is a drone antisubmarine helicopter designed to be operated from a destroyer. DASH will be effective against fast deep nuclear submarines.

"The MISSILEER will be a subsonic fighter aircraft armed with long-range supersonic missiles, which will enable us to extend our fleet and antiair warfare zone. The MISSILEER system will have a multitarget attack capability with its EAGLE missiles.

"Under this category, developmental effort continues on items essential to the operational deployment of aircraft and improvement of their capabilities. This effort includes Vertical Takeoff Aircraft, airborne components for target classification, detection and tracking of submarines, aircraft propulsion, and survival and safety equipment. In addition, the effectiveness of all of our offensive weapons systems is dependent upon a defense against probable enemy countermeasures and the ability to counter enemy detection and attack equipments. This fact and the rapidly advancing state-of-the-art in jamming and deception makes it mandatory that we continue to emphaszie our research in countermeasures techniques.

"GUIDED MISSILES AND RELATED EQUIPMENT

"Guided Missiles and Related Equipment is funded at the highest level of any of the end item categories in the R.D.T. & E. program. This missile program provides the best balance attainable between the needs of the present and the future in both conventional and nuclear warfare. Developments underway will provide missile systems with increased range and altitude performance, multiple target capabilities,

interchangeable high explosive and nuclear warheads and improved homing guidance systems.

"The major item in this category is POLARIS. Another major item is the funding of the fiscal year 1961 increment for the development of the Pacific Missile Range complex. Fiscal year 1959 and 1960 funds have provided for the initial instrumentation requirements at the launching sites and down range. The fiscal year 1961 funding request for PMR will allow the outfitting of these installations to progress in an orderly manner and will provide for the operation and management of existing facilities, a large portion of which will meet the joint user needs of the Army, Air Force and NASA.

"Other major programs in the Guided Missiles and Related Equipment category include the strike warfare missiles EAGLE, TYPHON, SIDEWINDER and CORVUS, and the antisubmarine warfare missile SUBROC.

"With EAGLE, a relatively new concept of air warfare is being adopted by the Navy. With this concept, the high performance is built into the missile instead of the parent aircraft. The design of the aircraft can then be optimized for long endurance time on station for the flexibility we need in carrier operations.

"The TYPHON missile systems, which were formerly called SUPER TARTAR and SUPER TALOS, are being designed as the advanced weapon system for our cruisers and destroyers. TYPHON will provide an increased range and altitude capability, will be effective against submarine-launched ballistic missiles, and will be capable of operating in a severe countermeasures environment.

"The SIDEWINDER1C is an excellent example of model improvement of an existing missile. This missile will have double the performance of the present SIDEWINDER which has been used so successfully.

"The CORVUS missile program is being continued to provide attack aircraft with a stand-off weapon of pin-point accuracy against the enemy's fire control and gun-laying radars, in order to permit effective penetration by naval carrier-based attack aircraft.

"The antisubmarine missile SUBROC is being developed to provide our submarines with an ASW weapon of significantly increased range and kill capability.

"MILITARY ASTRONAUTICS AND RELATED EQUIPMENT

"The Navy is extremely interested in the use of space for increasing the capabilities of naval operating forces, and is actively engaged in research and development in this field. The military astronautics and related equipment category of this budget submission provides for Navy participation in the communications, navigation, and weather satellite projects of the Department of Defense and NASA. The Navy is prepared to assume management and funding responsibility for TRANSIT, the navigational satellite, and SPASUR, the satellite surveillance system. Requests have been made for the transfer of both of these projects to the Navy. This category of the budget also includes funds for studies in advanced space technology, satellite applications, satellite reconnaissance countermeasures research and satellite navigation as well as other investigations on the possibilities of the tactical use of space for the accomplishment of naval missions.

"SHIPS AND SMALL CRAFT AND RELATED EQUIPMENT

"Under the ships and small craft and related equipment category are developments which will greatly improve the capabilities of our ships to fulfill their missions in both total and limited war. Increased emphasis is being placed on improvements in antisubmarine warfare effectiveness, especially in sonar surveillance and classification of targets.

"The funds for shipboard sonar development will provide for a significant improvement in the ability of our surface ships and submarines to detect and track fast, deep running nuclear submarines. The variable depth sonar will enable us to place our sonar transducers and receivers below the ocean thermal layer, increasing detection range and probability significantly.

"Another major improvement is a shipboard sonar which employs new techniques of bottom bounce and convergence zone operations.

"Radar is, of course, the most important surveillance system for the location and tracking of enemy aircraft, missiles, surface vessels, and surfaced or partially surfaced submarines. Our radar developments continue to receive strong support aimed at long-range detection of fast, small, high-flying missiles and aircraft.

"With the development of improved surveillance equipment, we must also provide efficient methods of handling the large amounts of detection and classification data which are generated. The system for doing this job is called the naval tactical data system. This system is being developed to give our forces afloat an integrated data system for keeping track of enemy and friendly forces, and directing our weapon systems to their targets.

"Perhaps the largest single development in the ships and small craft category is the development of an improved steam catapult and a new internal combustion catapult for carrier flight operations. These powerful catapults are required to accommodate our modern high-performance all-weather aircraft. More powerful arresting gear for carrier operations is also being developed.

"The ships of the future will benefit significantly from the extensive effort being made in the development of advanced types of propulsion systems. The propulsion of ships by nuclear energy is an accomplished fact and improvements continue. Closely related to this propulsion work is an intensive effort in ship noise reduction to reduce the possibility of detection by enemy sonars and to increase the detection ranges of our own equipment.

"ORDNANCE, COMBAT VEHICLES, AND RELATED EQUIPMENT

"Included in the ordnance, combat vehicles, and related equipment category are the various developments in antisubmarine warfare torpedoes. Examples of these are the MK–44 acoustic torpedo; the wire-guided MK–37 torpedo for use by destroyers and submarines; ASTOR, a long-range, high-speed, wire-guided wakeless nuclear warhead torpedo for use by submarine against submarines and surface ships; and ASROC, a ship-launched rocket assisted torpedo for use against submarines.

"This program includes a substantial effort in the field of antisubmarine mining. We are at work on three types of sea mines: A moored type capable of being laid by submarines and two air-laid types, all of which are highly effective against submarines.

"The Marine Corps' new artillery systems, for direct support and for general support, are included in this category. These two systems are designed to improve the Marine Corps' vertical envelopment amphibious assault capability by providing increased range, firepower, and accuracy while reducing weight and bulk at the same time.

"Also included is an amphibious support vehicle, designed to increase the speed with which personnel and material can be landed in an amphibious assault.

"OTHER EQUIPMENT

"The category other equipment includes a significant part of the electronic and communication developments of the Marine Corps. Included are a mortar-locator radar, a lightweight amphibious surveillance radar, a lightweight long-range early warning radar, a tactical data system, and new radio equipment for control of ground operations and close air support. These equipments are all helicopter transportable in keeping with the vertical envelopment concept of the Marine Corps.

"PROGRAMWIDE MANAGEMENT AND SUPPORT

"No systems or component developments are included in the programwide management and support category. This category supports indirect costs at certain of our research and development field activities which are not identifiable with other budget projects. Examples of these costs are maintenance of buildings, grounds, roads, utility systems, and security.

"SUMMARY

"In summary, the fiscal year 1961 research, development, test, and evaluation program in this budget request is based on a careful analysis of the operational requirements of the Department of the Navy. It will provide a balanced, integrated, and continuing program which represents the most carefully planned effort, consistent with the budgetary limitations and national policy."

Admiral HAYWARD. If it is satisfactory with you, Mr. Chairman, maybe I should ask Admiral Bennett to discuss some of the details of the research program, as such, and then go into specific questions on systems and the overall program.

Mr. MAHON. I think it would be better to have a great degree of presentation of the overall program before we go into a period of interrogation. An overall statement is helpful, but I think it would be good to get a little deeper into it.

You have made available to us quite a bit of the helpful information. One of the things which you have provided and which I thought rather interesting is entitled "Fiscal Aspects of the Fiscal 1961 Budget Request, Discussion by Admiral Bennett, Chief of Naval Research."

I suggest, Admiral Bennett, that you proceed in your own way.

Admiral BENNETT. I would like to take just a few minutes, Mr. Chairman, to go into a few of the general aspects of the research program, and right after that I will go right to the document you mention.

Mr. MAHON. Yes. I did not suggest that you go to the document which I mentioned immediately. I think it would be better for you to make your presentation without interrogation. We can make notes of questions we may wish to ask as a result of some of the statements which you will make.

Admiral BENNETT. I have no prepared statement as such on the research program. I would like to speak briefly to a few points.

This committee has always been interested in the results we get for the money and I will attempt by selecting a few of the many, many possible items on which we have results to show some of these results.

SPACE PROGRAMS

Space is a popular phase these days; so let us start there. Our radio astronomy program is going very well. We commissioned a new telescope at the University of Michigan, which is tying in with the optical sun astronomy program there to study better the influence of the sun, which vitally affects so many things on this earth.

We have also commissioned two 90-foot telescope dishes at California Institute of Technology. These operate together to give data of very great precision at the site, which is at Bishop, Calif. In 2 months of complete operation nine remote radio sources up to 1 billion light years away have been identified as contrasted with the five which were all that were known to man previously.

We have also charted better the known celestial objects with greater accuracy and obviously improved radio star positions can be vital to and have obvious military uses.

Going a little closer, let us look at radio astronomy briefly. The Naval Research Laboratory has shown that X-rays rather than ultraviolet are the big cause of magnetic storms on earth that disrupt communications. We also have wide spectrum recordings of light from the sun. Moving closer to earth, the strato-balloon program is producing still more results. Pictures of the sun taken with a 12-inch telescope over 80,000 feet, free of our air, will tell us much of the sun surface reactions as we analyze them. You may have seen in the papers that NASA will join us and the National Science Foundation in a larger telescope and future heavenly examinations.

In another area we are using balloons to investigate ultrahigh energies of the cosmic rays. High energy machines on earth run to a few billion electron volts. Primary cosmic rays, on the other hand, unfiltered by the atmosphere, run very much higher.

With Skyhook balloons, 33 hours of measurement were obtained at 120,000 feet on a photo emulsion load of 800 pounds. As an aside, this is probably the most international program in history. It took the United States, Europe, Canada, Australia, and India to provide the payload for this balloon. Many records were obtained and detailed analysis is going on.

Some of these high energy strikes of cosmic rays may have some influence on space travel of the future. Two byproducts are very interesting. First, the very production of balloons—and these are of 10 million cubic feet capacity, 550 feet tall—they can lift heavy loads above the atmosphere. This is a much cheaper way of doing some of our research rather than by satellites, since the balloons themselves only cost about $7,500.

Second, the International Cooperative Hurricane Net worked on the weather for these flights. The results were really surprising. The high altitude winds in the Caribbean differ from theory, and significant results are sure to come from the weather observations alone.

Previously this committee has heard of our efforts to design and use inexpensive rockets for research. I refer, of course, to ARCAS and ARCON, which respectively cost only $630 and $3,500. In addition to our own specialized uses, the six missile ranges use these rockets in the regular course of business. They are also used in the world's first synoptic meteorological net with rockets from three simultaneous shooting sites in North America.

PROPELLENT CHEMISTRY

The committee has heard many times of our propellent nitorchemistry. The latest serial installment is the pilot production of constituents for the advanced POLARIS propellant. The contractor has recently paid tribute to the foresight of the Navy in starting and supporting the necessary research for the past 12 years, which makes this family of propellants possible.

METALS RESEARCH

Columbium, a practical metal for strength at temperatures in the 1,800 to 2,500° F. range, oxidizes within minutes. NRL has discovered that coating the columbium with ordinary zinc creates a protecting layer of complex zinc-colombium oxide. Further, this layer tends to be self-healing—that is, when flows or strains break the coating, it tends to reform even when the temperatures run up to 2,200° F. for considerable periods of time.

The photograph Mr. Flood now has shows an example of unprotected and protected columbium at elevated temperatures. I think that one is at about 1,800°. One piece went completely apart, oxidized, and the other is substantially unchanged. This is quite a breakthrough in the area of high temperature metals.

OCEANOGRAPHY

Incidentally, the theory of this thin film protection of metals could be of the greatest importance for others. I am sure the committee has read in the press of the recordbreaking dive of the bathyscaph. What has not been highlighted is the fact that last year we had 12 scientific dives made to prove the worth of this device before we purchased it. Further, now that we hold the record vis-a-vis the Russians, a lot of dives to lesser depths for oceanographic data will be made soon. We are considering other deep diving research vehicles for future use having more mobility.

RADIATION PROTECTION

We must monitor personnel who are exposed potentially to the hazards of radiation. At present a film badge dosimeter is used, requiring dark room equipment. It is not reusable. NRL has developed a new one, 20 times more sensitive, easier to read, and less expensive.

This dosimeter consists of a special calcium fluoride thermoluminescent on a plate enclosed in an envelope with a glass window. The powder absorbs energy from the radiation. To read the monitor gentle electric heat is applied and light is given off from the stored radiation energy. The peak brightness of the glow is a measure of radiation dose.

USE OF COLD AS ANESTHESIA

Today most people know a little bit about the use of cooling and of cold as a form of anesthesia involving heart and lung surgery. This helps to prevent stoppage of some of the body functions and body deterioration. Since the circulating blood is to be diverted through a heart and lung machine anyway, someone hit on the idea of lessening the time to cool the body by cooling the blood external to the body, in the first place. Because of their knowledge of healing and cooling processes, NRL scientists were chosen for the work. A mechanical heart pump with temperature regulation has been developed, used in experimental operations, which leads to cardiac and lung surgery of types not before possible, because of the speed with which you can reduce the body temperature for effective operations.

VANGUARD PROGRAM

I would like to take 1 or 2 minutes to finish off with this committee with a few final words on the VANGUARD project. Contrary to popular opinion, this project was eminently successful. Of the seven VANGUARD vehicles employed to put satellites in orbit, three were successful. This is an outstanding record when you note that this was a new rocket designed with three engines. All three of these are still in orbit.

The last one, a full-scale satellite, reported environmental conditions, studied the earth's magnetic field, and examined solar X-rays.

The second one, full-scale, examined meteorological data. Scientists are still studying the masses of data from these satellites to determine final conclusions. Both were battery-powered and are now silent.

VANGUARD–I, the baby moon, was placed in orbit March 17, 1958, tomorrow will be the second anniversary, with a perigee, or closest approach to the earth, of just over 400 miles, the highest of any earth satellite. This attests to the excellence of the vehicle propulsion and guidance systems.

The very excellent, extremely stable orbit makes possible through observation of flight changes the determination of earth shape irregularities and the far outer atmosphere characteristics.

The oblateness, or flattening of the poles, of the earth was revised by this. This is of importance in accurately mapping the earth and understanding its internal structure.

Refinement of the geodetic data from VANGUARD–I showed that the earth was asymmetrical; that is, slightly pear shaped. To understand the sensitivity or accuracy of the measurement, it should be noted that the pear-shaped deviations are about 50 feet in the 4,000-mile radius of the earth.

VANGUARD satellites' motion showed the density of the atmosphere at 400 miles up was many times greater than had been supposed and predicted. This density knowledge is very important in understanding the nature of the atmosphere. Density affects the flight of all satellites.

Further, these VANGUARD measurements showed the outer atmosphere density was variable and could be correlated with solar radiation. This direct connection between sun activity and state of our atmosphere is important in understanding changes occurring. Incidentally, it was thought that meteoritic dust might sandblast and seriously damage satellites. The very fact of continuing radio transmissions from VANGUARD–I shows that normally this erosion is not serious.

It is interesting to note that as of tomorrow morning, Mr. Chairman, VANGUARD–I will have been in continuous radio transmission for 2 years on solar power.

I have a very few notes in the completely classified area, and I might finish with those. We are sometimes accused of not paying attention to research for ASW.

SATELLITE DETECTION

Admiral Hayward already mentioned that we have established a partial radio fence across the United States for the detection of satellites. A thin beam of radio waves is projected upward, and waves reflected from any satellite passing over it are picked up by receivers several hundred miles away.

I might mention also in passing that the certain amount of confusion over one of the recent satellite objectives was not discredit to the system. It simply reflected the fact that the interpretation of the data, the read-out of the system, had not been completed and it took time to go back through the records and be sure what was going on.

ANTISUBMARINE WARFARE

To return briefly to ASW, the use of the mathematics of information theory, the use of digital computers in sorting data, in steering ——— and many other things are slowly but surely going to improve our handling the ASW problem.

On the other hand, as a result of 22 years of my own experience in this problem, I think it is safe to assume that it must be solved in pieces. There is no foreseable breakthrough, if by that we mean a single system or black box that is going to solve the problem simply, cheaply, and forever.

TRAINING DEVICE

In the training area, a training target for ASW has passed preliminary evaluation and production prototypes. This is like a torpedo—will run for 3 hours at 8 knots and furnish an economical target.

POLARIS shipboard team trainers are being provided to provide team training and performance evaluation.

The HAWK missile system trainer for on-site complete training, using operational equipment but without live targets or missiles, is under development by our training devices center. One feature of this is interesting. It is jointly sponsored by the Army and Marine Corps.

(Discussion off the record.)

Admiral BENNETT. One particular reason for mentioning this, Mr. Chairman, is the background of this work lies in over 20 investigations going back nearly 40 years. Involved were the universities, the Bureau of Standards, Naval Ordnance Laboratory, and predominantly the Naval Research Laboratory. The titles nor the text of these 20 investigative papers never mention submarine detection, none of the research was aimed at that specific problem.

Over the years that have gone by, the fiscally minded, so-called practical men, no doubt attempted many times to eliminate the so-called useless project. Fortunately, since it looks as though we have a system that at least will be useful for some purposes, this research was done. It is too early to wax overoptimistic about this system, but I thought it was interesting to notice that research with no apparent connection with ASW has produced an interesting system.

That is all I have on that subject, sir. If you like, I will go into the fiscal data. I believe the members of the committee have these four charts.

FISCAL DATA

CHART NO. 1

Comparison of fiscal year 1961 budget estimates—Research, development, test, and evaluation, Navy

[In thousands of dollars]

	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961	Difference, 1961 compared with 1960
Total comparative unobligated balance brought forward	$32,048	$57,507	$61,805	+$4,298
Total comparative new obligational authority	1,174,310	1,256,725	1,169,000	−87,725
Minor comparative transfers included in comparative new obligational authority but excluded from comparative obligations	−1,828	−1,288		+1,288
Total comparative obligations	1,204,530	1,312,944	1,230,805	−82,139
Comparative obligations	1,147,023	1,251,139	1,207,500	−43,639
Total comparative unobligated balance carried forward	57,507	61,805	23,305	−38,500

The unobligated balance brought forward in fiscal year 1961 is $4.3 million greater than the amount brought forward in fiscal year 1960. With the transfer of additional test and evaluation items, it is anticipated that approximately $20 million to $25 million of pro-

gramed funds normally will remain unobligated at the end of each fiscal year because contractual negotiation will extend beyond the fiscal year for an unknown number of approved projects. However, the unobligated balance of $57.5 million at the beginning of fiscal year 1960 included $25.5 million which was transferred from the DOD emergency fund late in fiscal year 1959. These funds were programed for basic research and for certain antisubmarine warfare projects, but the contractual negotiations were not completed until fiscal year 1960. The unobligated balance of $61.8 million at the end of fiscal year 1960 includes the normal unobligated balance and, in addition, approximately $39 million which will be programed and committed but will not be obligated under the current fiscal year 1960 financial plan.

The new obligational authority of $1,169 million for fiscal year 1961 reflects a decrease of $87.7 million from the fiscal year 1960 comparative new obligational authority, comprised of a decrease of $5.4 million in the POLARIS program, $11.9 million for the Pacific Missile Range, and $70.4 million in the remainder of the research, development, test, and evaluation program.

Although the request for new obligational authority in fiscal year 1961 is $87.7 million below the fiscal year 1960 comparative level, comparative obligations reflect a significantly smaller decrease of $43.6 million. This is due to the fact that projects totaling approximately $39 million which will be programed and committed under the fiscal year 1960 financial plan, will be carried into fiscal year 1961 for obligation.

The unobligated balance of $23.3 million to be carried forward at the end of fiscal year 1961 is estimated as the "normal" balance.

Chart No. 1 is the overall fiscal picture.

CHART NO. 2

Comparative new obligational authority by budget activity "Research, development, test, and evaluation, Navy," fiscal year 1961 budget estimates

[Dollars in thousands]

	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961	Difference
Office of Naval Research	$109,121	$99,030	$92,162	−$6,868
Bureau of Naval Weapons	877,842	948,394	902,286	−46,108
Bureau of Ships	168,477	181,631	143,973	−37,658
Bureau of Medicine and Surgery	4,794	4,802	5,309	+507
Bureau of Yards and Docks	3,808	3,983	4,093	+110
Bureau of Supplies and Accounts	2,264	2,180	2,140	−40
Bureau of Naval Personnel	764	800	1,008	+208
Marine Corps	7,240	15,905	18,029	+2,124
Total	1,174,310	1,256,725	1,169,000	−87,725

Chart 2 reflects a distribution of comparative new obligational authority by the organizational units responsible for conducting the Navy R.D.T. & E. program. The major changes are in the programs of the Office of Naval Research, the Bureau of Naval Weapons, the Bureau of Ships, and the Marine Corps. They represent the net result of various increases and decreases in numerous technical projects.

The reduction of $6.9 million in the ONR program is due primarily to the fact that most of a major experimental program to determine the feasibility of ocean area surveillance ———— will be completed with the fiscal year 1960 funds.

The reduction of $46.1 million for BuWeps includes decreases of $5.4 million for POLARIS; $11.9 million for the Pacific Missile Range; $19.2 million in regular missile programs resulting from reduced levels for research and development on the entire family of missiles except one air-to-air missile; and $9.5 million in some antisubmarine warfare programs which are nearing completion of the development stage.

The decrease of $37.7 million in the BuShips program is comprised of decreases in a large number of projects, partially offset by increases in the fields of mine countermeasures and antisubmarine warfare. The largest single decrease is reflected in Project ATLANTIS; it is anticipated that the $10 million provided for this project in fiscal year 1960 will carry it well into fiscal year 1961.

The increase of $2.1 million for the Marine Corps is comprised primarily of increases for the close support artillery system, general support artillery system, and the amphibious support vehicle area, partially offset by decreases due to the completion of the research and development phase of the redeye missile system and the landing force air defense radar AN/MPS–21.

CHART NO. 3

Comparative new obligational authority by type of activity "Research, development, test, and evaluation, Navy," fiscal year 1961 budget estimates

[Dollars in thousands]

	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961	Difference
Government facilities	$423,067	$429,271	$461,561	+$32,290
Industrial facilities	670,277	761,058	641,512	−119,546
Colleges, universities, and nonprofit institutions	80,966	66,396	65,927	−469
Total	1,174,310	1,256,725	1,169,000	−87,725

Chart 3 reflects a distribution of new obligational authority by the type of activity which will incur the obligations; i.e., Government facilities, industrial facilities, and colleges and universities.

The increase of $32.3 million at Government facilities results from a shift of effort to Navy laboratories from industrial facilities under the POLARIS program and the Pacific Missile Range. The increase for the POLARIS program is principally due to additional effort on propulsion development and standardization programs at naval installations. There is increased on-station effort at installations compromising the Pacific Missile Range, in addition, the Kwajelein-Johnson antimissile range becomes a part of the Pacific Missile Range complex on July 1, 1960.

The decrease of $119.5 million in work at industrial facilities results from the phasing out of certain contractual work for the POLARIS program, from reduction in ground instrumentation procurement for the Pacific Missile Range, and from the decrease in the

total program which falls primarily in the area of development and test and evaluation contracts.

The estimates for colleges and universities reflect a continuation in fiscal year 1961 of approximately the same level of effort as planned for fiscal year 1960.

CHART NO. 4

Comparative new obligational authority by budget project, "Research, development, test, and evaluation, Navy," fiscal year 1961 budget estimates

[Dollars in thousands]

	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961	Difference
1. Military sciences	$132,493	$122,771	$113,389	−$9,382
2. Aircraft	92,727	92,769	988,129	+5,360
3. Missiles	633,184	694,535	658,203	−36,332
4. Astronautics			1,272	+1,272
5. Ships and small craft	163,027	174,527	138,834	−35,693
6. Ordnance, combat vehicles	70,940	74,688	70,949	−3,739
7. Other equipment	36,365	52,552	42,699	−9,853
8. Programwide management and support	45,574	44,883	45,525	+642
Total	1,174,310	1,256,725	1,169,000	−87,725

Chart 4 reflects a distribution of comparative new obligational authority by the standard classifications used throughout the Department of Defense budget presentation for the research, development, test, and evaluation program. Net changes and major items comprising the changes follow:

1. *Military sciences.*—The decrease of $9.4 million is due primarily to the completion of most of Project Artemis with fiscal year 1960 funds.

2. *Aircraft and related equipment.*—The increase of $5.4 million is primarily for intensified research and development and facilities for the Missileer program; setup of vertical take-off and landing assault transport program; and studies for aircraft active and passive countermeasures.

3. *Missiles and related equipment.*—The reduction of $36.3 million consists of decreases of $5.4 million for POLARIS; $11.9 million for the Pacific Missile Range; and $19.2 million in regular missile programs.

4. *Military astronautics and related equipment.*—Four programs will be initiated: Advanced space technology, satellite applications, satellite reconnaissance countermeasures research, and satellite navigation.

5. *Ships and small craft and related equipment.*—The decrease of $35.7 million is comprised of decreases in a large number of projects in this activity partially offset by increases in mine countermeasures and antisubmarine warfare. The largest single decrease is reflected in Project Atlantis; the $10 million to initiate this project in the latter part of fiscal year 1960 will carry it well into fiscal year 1961.

6. *Ordnance, combat vehicles, and related equipment.*—Decrease of $3.7 million is due to some antisubmarine programs nearing completion of the development stage, partially offset by increases in some artillery systems.

7. *Other equipment.*—Decrease of $9.9 million due to reductions in programs such as airborne equipment for target acquisition and localization, and automatic all-weather land and sea aircraft visual landing aids.

8. *Programwide management and support.*—Increase of $0.6 million for priority repair and improvements in facilities and in contributions to the Government employees' health insurance plan.

As you know, Mr. Chairman, the details of the differences are contained in your unclassified brown justification book.

Mr. MAHON. Do you have any further regular presentation?

Admiral HAYWARD. No, sir. I am prepared to discuss any of the systems you want to and prepared for questions on the program in detail.

LEVEL OF RESEARCH, DEVELOPMENT, TEST, AND EVALUATION EFFORT

Mr. MAHON. I assume that probably most members of the committee, and most Members of Congress, would feel that your requirements estimate of about $1.2 billion reflect a research, development, test, and evaluation program which is not overly ambitious.

As you said earlier, rarely does Congress reduce your research, development, test, and evaluation. I think that one or two times in the past we have rapped the services on the knuckles for projects we did not think were too valid and made slight reductions.

We made slight reductions in order to try to stimulate better operation and management in research, development, test, and evaluation. We have made slight reductions in order to try to enforce better contracting of research and development work, and so forth.

This has been done in an effort to stimulate more effective research, development, test, and evaluation, and not in an effort to cut it down. We are all rather research and development minded, I feel sure, and I think that is a proper attitude.

Admiral HAYWARD. As you can see, Mr. Chairman, the Comparative total for the research, development, test, and evaluation program, including the test and evaluation in 1959 was $1,174,310,000; in 1960, it was $1,256,725,000; and in 1961 it is $1,169 million.

It is relatively a level effort and it is a little lower than 1959, actually.

Mr. OSTERTAG. Will the chairman yield at that point?

Mr. MAHON. Yes.

Mr. OSTERTAG. Admiral, mention has been made of the fact that research and development now includes test and evaluation.

Admiral HAYWARD. Yes, sir.

Mr. OSTERTAG. Therefore, there would be a difference in the overall figure from the standpoint of research and development from what existed prior to now so that your research, development, test, and evaluation ought to be pretty much comparable to research and development of the past, plus test and evaluation, which has been located in other parts of your budget?

Admiral HAYWARD. Yes, sir.

Mr. OSTERTAG. Putting the two together, how does that compare?

Admiral HAYWARD. Taking the ground rules now, in 1959 we would have had $1,174,310,000, under the present definitions.

In 1960, we would have had $1,256,725,000, whereas in 1961 it is $1,169 million. It is less than 1959 and less than 1960.

Mr. OSTERTAG. When you made up your budget figures for 1959, did you include what was in the other parts of the budget for test and evaluation?

Admiral HAYWARD. That is correct; yes, sir. We went back and redid that because I was sure the committee would be interested in seeing the comparison under the new ground rules for the appropriation.

NUMBER OF PROJECTS

Mr. MAHON. Approximately how many projects and subprojects do you have in research, development, test, and evaluation at the moment in the Navy?

Mr. WARSING. We have approximately 450 projects contained in the project listing furnished to the committee.

Mr. MAHON. Approximately 450 projects of all types?

Mr. WARSING. Yes, sir.

Mr. MAHON. How would that compare to 5 and 10 years ago?

Mr. WARSING. The composition of the projects would have something to do with this. You will understand that this count is on a very broad category basis and the 450 projects then would be subdivided by subprojects, and by tasks. The task would be the next subdivision of a project.

Mr. MAHON. If you made the greatest number of subdivisions to indicate the various facets of your research and development, how large would that figure probably be?

Admiral BENNETT. There are approximately 9,000 tasks.

Mr. MAHON. All right.

I do not believe my question was answered as to a comparison between the number of projects and activities 10 years ago and 5 years ago? Could you give us a general idea of that and maybe sharpen it up for the record later?

Admiral BENNETT. I believe we can furnish that for the record. I would hesitate to do it, although I was involved 10 years ago.

Mr. MAHON. I would say the number of projects probably has increased.

Admiral BENNETT. I would say that probably they increased only slightly. You remember, Mr. Chairman, at the end of the war you had a tremendous number of projects and many of those were canceled, combined, and reoriented. Then Korea came along and the number went up again. It might be surprising to see that actually we have changed very little in the sort of average of the postwar area.

We will supply those figures.

(The following statement was supplied:)

Ten years ago the Navy budget included approximately 2,700 line items; these have now been consolidated into broader categories so that the current budget contains 450 line items, or projects. The number of tasks 10 years ago approximated the current number of tasks, 9,000.

MANAGEMENT OF PROGRAM

Mr. MAHON. It is obvious that the management of such a highly technical and farflung program is a very considerable job. It is

not the responsibility of this committee to manage these projects and we could not do it. Our concern is whether or not you are properly managing them. That is our duty as I see it, as Representatives of the Congress on this subject.

Have you observed, in your time, Admiral Bennett, any marked improvement in the management, coordination and elimination of unnecessary duplication in R.D.T. & E., or has the trend been the other way?

Admiral BENNETT. Mr. Chairman, I would like to affirm that program management has highly improved over anything we had before. Each item is most carefully considered at several operating and policy levels. It is the subject of intense study for months, and I doubt if we have ever had a better reason and more properly proportioned program within the available funds programed in our past history.

Mr. MAHON. Would you echo that, Admiral Hayward?

Admiral HAYWARD. Yes, sir.

I have been involved in this a good many years, and, specifically, with this committee this is the fourth year. I would say it has improved tremendously and we have had to be more selective in what we go for in systems as for everything else. This has been good. It is a full-time job, of course, but it has improved. I think we are in a sounder position now from a management point of view than we have ever been.

Mr. MAHON. Are we throwing more and more, or less and less, good money after bad in R.D.T. & E. in the Navy?

Admiral BENNETT. I doubt if we are throwing very much money after bad, Mr. Chairman. We do not have it to throw.

Mr. MAHON. In the eyes of the poor taxpayer who chafes under the burden of high taxes, a billion dollars is still a lot of money.

Admiral BENNETT. Yes, sir.

CANCELLATION OF RESEARCH PROGRAMS

Admiral HAYWARD. My feeling is that we should not hesitate to cancel things. You do this: You do a lot of research, you do quite a bit of developing, a lot of developing, and then when you get into the area of procurement; that is where the big money is, and this is where we just have to cut down on the mistakes.

Mr. MAHON. Why did you not step in long before you did and cancel the SEAMASTER that cost us half a billion dollars? It was under R.D.T. & E. a long time.

Admiral HAYWARD. Mr. Chairman, in the fall, or the early part of 1958, I wrote an official memorandum recommending the cancellation of that program. It was a matter of record here in Congress that I wrote a memorandum recommending cancellation because of the SEAMASTER's inability to perform the technical functions claimed for it. That was my own opinion and I gave it to the Secretary.

Admiral BENNETT. Mr. Chairman, frequently we are accused of carrying on research until it dies on the vine. It is interesting to note that in the Office of Naval Research alone there were 312 contracts completed in fiscal 1959, while 320 were initiated.

Out of the total activity contracts of 2,000, this is a fair percentage of finishing or getting rid of any possible deadwood. It must be noted that most of these contracts run for 3 years or more to get any results.

Mr. FORD. What about cancellations, Admiral Bennett?

Admiral BENNETT. I do not have those figures here, Mr. Ford, but we have them in another paper and I will be glad to supply them. We have cancelled quite a few tasks. In the total Navy R.D.T. & E. program, 153 tasks were terminated in fiscal year 1959.

Admiral HAYWARD. In the systems business, we have come down in systems. I agree with Mr. Franke and Admiral Burke, that it is selectivity in the systems business that we can do a much better job on. We have cancelled big systems. We have cancelled REGULUS II, TRITON, and we have cancelled the SUPER TARTAR.

I believe it is better to cancel something rather than drag it on year after year underfunded. It is more efficient to bring the system into being in a hurry. You probably heard about the subject of trying to invent on schedule, and that is why I opposed this. There are some very horrible examples of this which I can use. I can give you a good example and a bad example.

A good example is the work that the Air Force did on the HOUND DOG. The Air Force was criticized by some people for going to the HOUND DOG missile when they went to a supersonic air-breather missile when some people wanted to have a Mach 9 ballistic missile.

They stuck to their guns and in a period of about 2 years put a system together using the J–52 engine and other existing components; right now you have a system.

The horrible example is BOMARC. BOMARC is still not a system, and this is what we try and do in selectivity. If you try and stretch too far, you go 11 or 12 years and you have no system; when you do get it, it is not worth anything.

EXPENDITURE CEILINGS

Mr. MAHON. Admiral, we have a carryover each year in the Defense Department of funds in excess of $30 billion that are unexpended. They may be obligated.

In former days, I took the position that if we funded a project that the services ought to move as rapidly as possible and perform, get the project underway, and accomplished. I did not feel that we ought to watch some sort of a chart and keep expenditures of funds previously appropriated within certain levels. If we have appropriated the money you are going to spend it, and you should spend it as fast as you can, if that is the quickest, best and most economical and most efficient way to accomplish results. We have gotten into the habit of trying to keep expenditures within certain levels even though the expenditures will ultimately be made. Delays usually increase costs.

I am just wondering whether this has been a good thing for the Department of Defense and research and development in particular.

Admiral HAYWARD. No, sir. I feel that any time you have an expenditure limitation, once the decision has been made to do something, it is going to cost you more in the long run. What happens? You

talk about management. We are just in the execution process of the 1960 budget and we are spending. We are getting the programs going. We know what we did in 1959. I am defending the 1961 budget here, and we are in the process of preparing the 1962 budget.

You have appropriations. You have obligations. You have apportionments, and you have expenditures. If you try and control the program in its management by expenditures, I do not think you do anything but pile a bow wave ahead of you. You do it that way and it costs you more, whether you are doing research and development, whether you are buying an airplane, ship, or anything. It costs you more if you try and control the expenditures and make that the control.

I agree that it does.

Mr. MAHON. Would you say that theoretically, aside from certain fiscal aspects, that it would be best to have no limitation at all on the rate of expenditures after the funds have been made available for a certain program or project?

Admiral HAYWARD. I believe that is the best way to manage a program; yes, sir.

Mr. MAHON. I hope that when we inaugurate a new President and he appoints a new Director of the Bureau of the Budget, we could follow that policy. I realize that it would cause, maybe, heavier spending in certain years, but I believe it would be far better for defense and for the country in the long run to follow that procedure.

Admiral HAYWARD. Yes, sir.

Mr. MAHON. It is completely out of focus now and has been for a long time.

I feel sure that we are paying more per unit cost for things in the Defense Department by reason of this arbitrary regulation on expenditures. I agree that you should very carefully determine whether or not you want to appropriate money in the first place, but once having determined to build a missile, it seems to me that if you have determined that you are going to do it and have appropriated the money, you ought to do it as rapidly as you can. That is good judgment. I wish we could quit this other procedure. It is very bad.

EFFECT OF DIRECTOR OF RESEARCH AND ENGINEERING ON NAVY PROGRAMS

Do you find that the Office of the Director of Research and Engineering in the Department of Defense—this is Dr. York's Office—is a stumbling block or is it a good thing for the Navy, on the record?

Admiral HAYWARD. Well, what upsets me about Dr. York's Office is that Dr. York's Office, in a great many instances, attempts to be a project engineer on a lot of things they cannot be. Personally, I am on his Research and Engineering Policy Council, and we are very fortunate to have a man of Dr. York's stature as the man in his position. Dr. York is an excellent technical man, but his staff, unfortunately, is not up to the level of Dr. York.

Mr. MAHON. Very few people are up to the level of Dr. York.

Mr. FLOOD. Certainly not in his glibness.

Admiral HAYWARD. Dr. York was associated with me in the Atomic Energy Commission, Mr. Chairman, and I was instrumental in selecting Dr. York at the Livermore Laboratory, and I have had my

difficulties with him. He is quite an excellent scientist. Maybe he does not have all of the management and administrative techniques that other people would want him to have, but I am very glad he was not brought up in the comptroller school. He is a good technical man.

Admiral BENNETT. May I make a remark here, Mr. Chairman?

Mr. MAHON. Yes.

Admiral BENNETT. Along the lines of your question, I think the real point at issue is centralization, rather than decentralization. The Congress, in part, is responsible for this in creating the very Office of Defense Research and Engineering, but when big business and industry, which is not nearly as big as Defense, is going in one direction of decentralization of responsibility and authority with only a broad general look such as the Congress gives to appropriations, and then to go into a more centralized system in the Department of Defense has never made sense to me.

Mr. LAIRD. The Navy has not gone for a centralized system?

Admiral BENNETT. No, sir.

Mr. LAIRD. One Navy laboratory does not know what the other laboratory is doing in some cases?

Admiral BENNETT. I doubt that statement.

Mr. LAIRD. When the questioning comes to me, I will give an example.

Admiral BENNETT. All right, sir.

Mr. OSTERTAG. How are you going to coordinate if you do not have that kind of a system?

Admiral HAYWARD. I agree that the Department of Defense Research and Engineering, Dr. York's Office, has a very valuable function to perform. He has a function in programwide coordination in knowing what we are doing, and in knowing what all the services are doing. When Dr. York or anybody tries to run a program from the basement in the Pentagon, there is going to be nothing but trouble. He is the programwide man and this is right, and he has to do this. I agree.

With Dr. Charyk, Mr. Richard Morse, and Dr. Wakelin, we have never had more competent service assistant secretaries for research and development than right today. Mr. Perkins who has relieved Dr. Charyk goes right along with them.

Mr. OSTERTAG. What is wrong with that?

Admiral HAYWARD. Nothing is wrong with this except when they try to run the projects from the basement of the Pentagon. A lot of staff over there attempt to try and manage something from there.

Mr. Chairman, this we learned a long time ago; the man who has to do the work has to have the responsibility and the authority to do it. When the decision is made that the work is going to be done, the decision and the programwide coordination belongs in Dr. York's office.

Mr. MAHON. Is it not true that Dr. York has reduced the various steps of review and more or less streamlined the operation during his period of service?

Admiral HAYWARD. That is correct. I see Dr. York, and we have ready access. He has done this.

Mr. MAHON. Our staff studies indicate that you now have fewer stumbling blocks, in a way, than you had at one time in these areas.

Admiral HAYWARD. That is correct. We do have problems with the Comptroller, and we always will, and we should have. We always should have if he is a good Comptroller. We will have problems, and we even have them in the Navy with Admiral Ensey.

Admiral ENSEY. As a defendant, may I offer an observation?

Mr. MAHON. Yes.

Admiral ENSEY. I think that Dr. York would make one of our most preeminent comptrollers. If you get a good man in there, tie a can to his tail, and he takes a "high priest" position as Comptroller, this, then, is a different point of view, or a different attitude, than Admiral Hayward has.

Mr. MAHON. Your remarks are well taken.

When Dr. York was before us it was perfectly plain that he is a most persuasive man. He expressed himself well and undoubtedly has a grasp of his subject far beyond the ordinary scientist or administrator in this broad field of research. I expressed to him the hope that he would not be wrong, because a man with his persuasiveness, should he be wrong, could do the country almost irreparable injury, it seems to me.

Admiral HAYWARD. That is correct.

Mr. MAHON. We want a give-and-take, hammer-and-tong attitude on these vital questions, and I assume that we will have it. I am sure we will have it as long as you are in your position, Admiral Hayward.

Admiral HAYWARD. We really have good arguments for them.

ADEQUACY OF NAVY R.D.T. & E. PROGRAM

Mr. MAHON. Taking into consideration the overall defense budget, do you think the program for R.D.T. & E. is reasonably and sufficiently ambitious?

Admiral HAYWARD. Yes, sir. I feel, as I said, it is not what I went forward for. It is not my requirements, let me say, but I think that under the decisions that had to be made, that the program would be adequate.

FUTURE OF THE NAVY

Mr. MAHON. I would like to get your impressions on the question which I am about to ask. It seems to me that in the field of research and development you ought to be able to look with a great degree of clarity in the future more than the operating Navy. If the cold war continues for another decade at about on the present level, what, through the crystal ball, would the Navy look like in 1970?

Admiral HAYWARD. This is a question we have to concern ourselves with, and I am delighted to talk on this. We are faced with two tremendous problems.

Let us take the period from 1965 to 1970, because everything from 1962 on to 1965 is pretty much settled right now. It is not going to change much.

I feel that from 1965 to 1970, unless drastic steps are taken to make more effective units out of each unit we have, and our numbers are coming down, our capability is going to come down, unless we really do something in the technical areas to improve the ability of each ship and each unit to do its job better. This involves aircraft, sur-

face ships, and submarines, because we are just not going to have the numbers to do the job.

It will look this way: Let us take this in various situations. Let us take the aircraft carrier and the aircraft and antiair-warfare situation. We will have put our antiair-warfare business onto the missiles really with the airplane as the vehicle. We will not go on from the mach 2.4 to mach 3 or mach 4 airplane. We will come back to the slower airplane, using the EAGLE concept. If we do our work on the components in the engine business, I hope we will have the lightweight thrust engine and maybe we can change the whole face of the carrier Navy by getting what I call a competitive VTOL or STOL aircraft that will reduce the size of our present ships and prevent our having to have large catapults, arresting gears, and things of that kind.

This particular problem is one that is a component problem. It is an engine problem and to get an engine of a thrust to weight ratio of about 14 to 1, or 15 to 1, and really prove it, is going to run us about $65 to $85 million in the size that we want. If we do this, I am sure that this one particular job would change the face of all of the services, the Army, Air Force, the Marines, and ourselves.

By 1970 we should have it—not before 1970 though; I doubt very seriously you would have it—but, from 1970 on, on the weapons side, I am sure we are going to have to really do our technical work in the HE business.

Mr. MAHON. In what?

Admiral HAYWARD. In the high explosive warhead because in this part of the war, you are never going to be sure that you are able to just rely on nuclear weapons. I feel that we have got to continue with high explosives for this, even in 1970. Nobody will have said you are sure you are going to use them, but this is a poltical question as much as it is a technical question. Any missile I get has to be good enough, and accurate enough, to use HE to be effective to compete. For instance, in this period of time, the gun will have disappeared from the Navy. We will be using surface-to-surface missiles rather than the gun. As a matter of fact, in 1966, we will have only twelve 6-inch guns in the Navy. What we have to do is to come up with a system that is competitive and economically makes good sense to use as a missile. It cannot be one of these things that cost a million and a half dollars a shot. It has to be a large item in production. We are going to have to have this particular system by this time, and I am sure that you will have had this sort of device on our ships.

The same goes for our surface-to-air defense for all of the ships such as the amphibious ships.

In other parts of the Navy, let us take the antisubmarine warfare business; I am sure that in that period we will have exploited the helicopters. The helicopter may merge into not only the helicopter, but an airplane too. In other words, instead of having two vehicles, you would have VTOL that could do the job in the 1970 period. You will have done a tremendous amount of work in the data processing systems, so that you will be able to take the data you have now and automatically do a better job in the antisubmarine warfare business in sensing and using passive techniques, long range techniques, that

you will have pretty much controlled the ability of the submarine to exist where you have these forces.

On the long range surveillance business, you may have come through with an active system by that time, but you always ask yourself the question: Suppose you do know the submarine is a thousand miles away? What do you do about it?

This is a problem and we will have gone through pretty much the long-range surveillance business.

FUTURE SUBMARINE THREAT

Mr. MAHON. Do you think that the sea will be infested with submarines of the opponent to a greater degree in 1970 than now and that the submarine threat will be greater than ever before?

Admiral HAYWARD. I say by 1970 the control of the sea is going to determine, from my point of view, whether the free alliance will continue to exist. If the Free World does not control the sea and use it, and can use it, the Communists will win. There may be better submarines but numberwise, I do not think you can control the sea just by submarines. The Soviets are going to have to be able to use the sea on the surface, and over the sea. I do not think that it will be of any greater degree. It will be of greater degree in the way of a threat to our homeland, really. I think in the 1970 era every submarine will be able to carry a missile. It will not be like the POLARIS system, a special thing. I think you will have a system that any submarine at sea could be a missile submarine, so in this era every submarine will pose a threat to our homeland. This is a problem that is not going to go away, but if we have a system, that also will make it quite certain to the opposition that they are going to be destroyed. The premium on surprise will have gone by 1970. You will wonder why we spent so many millions of dollars for systems when when surprise will mean nothing.

No matter what he does, he is going to be destroyed. If we haven't taken the premium out of the surprise attack by 1970, we will not have done our technical work, and we have not done our job.

On things like MIDAS, BMEWS, and all that, that will be long gone. No matter what he does, he is going to be destroyed, and he knows this; so it will not be just one, but it will be a mix. He knows this.

In that era, the cold war and the ability to help our friends and use the sea is going to be more important than ever.

I think in the amphibious business, we will have been able to meet the Marine requirements for vertical envelopment, in vehicle speed, and we should have much better weapons for them—lighter, more effective. In the overall amphibious situation, I think that we will be in a much better position than we are today.

Mr. MAHON. If you wish to expand on that for the record, would you, please do so later?

Admiral HAYWARD. Yes, sir.

(The information follows:)

During the next 10 years, we do not expect the overall numbers of submarines of our opponent to increase appreciably but we can be sure that the quality and capabilities of the individual submarine will improve significantly. This im-

provement will be achieved through the introduction of nuclear power which will permit our opponent to maintain more submarines at sea for longer periods, and through the development of various types of submarine launched missiles which will increase the offensive armament of these submarines. As a result, the potential threat posed by an enemy submarine force will be greater than it is today unless we develop our capability to locate, maintain contact with, and destroy all submarines at sea.

Mr. MAHON. Would you comment on the question I asked, Admiral Bennett?

Admiral BENNETT. About the era in 1970?

Mr. MAHON. Yes.

Admiral BENNETT. I think that many of the things that Admiral Hayward is talking about are going to come from research that will be done in the next few years, or which has already been done, but has not yet been processed into development. One of the things that Admiral Hayward mentioned is the necessity for having less costly systems, of having ships that are more effective. Research has been going on for some time in such things—some in industry as well as in the Department of Defense—what is loosely called automation, for example. We literally do not know exactly how many of these things are going to be done. We do know, and we are able to prove, even within the Navy, Mr. Chairman, that the research which was started a few years ago and that is going on now is going to vitally affect our ability to do the sort of things that Admiral Hayward is talking about.

LEADTIME REQUIRED IN WEAPON DEVELOPMENT

Mr. MAHON. We have been concerned about the problem of leadtime. We have been told for years that it takes 7 or 8 years to go from the beginning stage to the operational weapon in this country. It has also been stated that the Soviet Union does this in much less time, 4 or 5 years.

Is there any validity to this criticism?

Admiral HAYWARD. Yes; there is. It gets back to what you were discussing before. Our budget process is such that the decision is really never a decision. I can point to many programs, but let us take one of the Navy's programs, the A–3–J airplane. The A–3–J is going along; we have evaluated it and it is ready. If we really want it to run off in the numbers we need, let us say 120 or 170, if you made that decision and went right ahead and did it, you would be able to produce those in short order. In the actual cycle of what goes on, each year the decision comes up; the decision is reviewed every year, and the decision—of course, the Comptroller has his viewpoint—is never a decision here. You are talking not technically, but you are talking more about administration.

Mr. MAHON. That is what you are talking about now?

Admiral HAYWARD. Yes, sir. When we made the decision to go to POLARIS, look what you have done to it as a good example. We made the decision and we stuck to it and Congress backed it, and we will have that system out, but I would not have believed it. Here is a real good example in leadtime if everybody stuck to the decisions.

Mr. MAHON. Nobody threw any monkey wrenches in it?

Admiral HAYWARD. Nobody threw any monkey wrenches in.

Mr. MAHON. We assisted by appropriating additional money.

Admiral HAYWARD. That is correct, and Congress deserves great credit. As a matter of fact, there would not be this gap in those submarines, if they had gone ahead and built them when we got the money. This is the decision.

OVERREFINEMENT OF WEAPONS

Mr. MAHON. Aside from that, what about the insistence by enthusiasts and perfectionists in having the utmost refinement in every weapon? Is that one of your problems, or is that just conversation?

Admiral HAYWARD. Mr. Chairman, you will always have this problem with the technical man. Some people, like Admiral Raborn, say, "This is what we are going to press with."

You can continue your improvements in making the decision but you will have a tendency with people in the technical business to want to say, "I will make another model, A, B, C, or D model, and we won't do anything until you get to that."

I do not think those are real serious.

Mr. MAHON. You do not think so?

Admiral HAYWARD. No, sir; I do not.

LEADTIME OF RECENTLY DEVELOPED NAVY WEAPONS

Mr. MAHON. Let us use a few projects as examples.

Would you indicate the time required to develop some of the Navy's new weapons such as the TALOS, SIDEWINDER, or any other weapons which have become operational recently? Give us for the record the cost of these projects and what was your experience in the leadtime on those weapons?

Admiral HAYWARD. Mr. Chairman, I had better pick out a specific system.

Let me pick out first an air-to-air one and then surface-to-air.

The SPARROW III weapon system, funded initially in fiscal year 1951 entered the fleet in 1958. This was the basic missile designed to arm the transonic F–3H–2 McDonnel "DEMON" aircraft. Research and development cost to achieve fleet introduction was $23.7 million. There are, however, state-of-the-art improvements to provide greater performance which are still being funded as well as changes to insure compatability with the F–4H–1, Phantom II, supersonic all-weather interceptor. Research and development in the SPARROW system is expected to close out with the fiscal year 1961 budget request.

Mr. MAHON. That is 10 years?

Admiral HAYWARD. That is 10 years.

Mr. MAHON. Do you think actually that we can, and will, reduce this leadtime and do a better job in this?

Admiral HAYWARD. Yes, sir.

We have SIDEWINDER I–C which is twice the weapon the original SIDEWINDER was. While the original SIDEWINDER took 7 years to reach the fleet, the advanced SIDEWATER will reach the operating forces in 4 years.

Mr. MAHON. If you wish, you can elaborate on that.

(A classified statement was submitted.)

Admiral BENNETT. Could I interject just one small remark?

Mr. MAHON. Yes.

Admiral BENNETT. It is an American characteristic to have everything as perfect as possible and there is a discernible difference between the attitude of some of our competitors abroad and our ability in America to demand perfection. This is something we have to fight all the time. I refer not only to the technical people Admiral Hayward referred to, but also to the operational people.

This is something we all have to fight against, even in our home affairs.

Admiral HAYWARD. The next missile, Mr. Chairman——

Mr. MAHON. Put that in the record, if you wish.

Admiral HAYWARD. All right, sir.

(The information follows:)

Detailed information on missiles is classified and has been provided separately for the committee use as part of Rear Admiral Stroop's testimony during hearings on "Procurement of aircraft and missiles, Navy."

Mr. MAHON. I want to place any information or suggestions which you may have, in addition to the ones you have already made, in the record, as to how we can shorten this leadtime. It seems to me it would be very significant.

(The requested information follows:)

There are two basic approaches toward shortening leadtime. One is to streamline the organization, such as the Navy has done in melding the Bureau of Aeronautics and the Bureau of Ordnance into the Bureau of Naval Weapons. The other is to pursue parallel development. This second approach was recommended 3 years ago by the special Department of Defense Committee chairmaned by the late Deputy Defense Secretary, Reuben B. Robertson, Jr., but such parallel development would be very costly to implement on a broad scale.

Establishment of the Bureau of Naval Weapons represents a major step toward shortening the timespan between the establishment of an operational requirement for a new weapons system and delivery of an operational version of the new weapons system to the fleet. Particularly noteworthy is the fact that we have brought within the cognizance of the new bureau most of the troublesome areas of split cognizance that have existed in the Navy both within missiles and between missiles and aircraft. In the brief operating period since the merger we have:

First, melded the skills of the outstanding professional and technical abilities available to the Navy in the two predecessor bureaus and reoriented their efforts to complete weapons systems;

Second, instituted a program management concept which combines the best horizontal weapons control with overall vertical program planning and guidance;

Third, strengthened the contracting functions and provided increased emphasis generally on the importance of business relationships.

Our primary objective in making these changes is to accelerate the progress of new weapons systems from the first establishment of the requirement, through research and development, then production, to fleet operation.

POLARIS PROGRAM AUGMENTATION

Mr. MAHON. I would like to talk about the POLARIS.

This is a sum of $374 million in this budget, I believe, for the POLARIS. Is this enough money to carry the POLARIS program forward in such a way that you can say the program is not restricted in any undue way as a result of inadequate funding?

Admiral HAYWARD. Under the original program on ships, that is correct. I personally feel that the program should be augmented.

Mr. MAHON. The Navy is working on that approach now, is that correct?

Admiral HAYWARD. Yes, sir. The Secretary of the Navy has forwarded his letter to the Secretary of Defense and I have forwarded mine to the Secretary of the Navy. As I told the committee, mine is in the record.

Mr. MAHON. How much money is involved in this whole alternative program?

Admiral HAYWARD. There is alternative "A" which means it will cost $930 million to increase from 3 to 9 the number of SBN's fully funded in the 1961 program.

Mr. MAHON. I am not sure whether we already have this in the record.

Admiral HAYWARD. You have my testimony along this line.

Mr. MAHON. Let us make sure that you put it in the record at this point, or make reference to where it appears in the testimony.

Mr. FORD. We will be more interested in the matter when the Secretary of Defense and the Bureau of the Budget make a determination. That is one of the issues involved here. We are very much sold on this program of POLARIS and I think we would be glad to accelerate it, but it would be good to have a budget estimate if that is going to be so.

Admiral HAYWARD. Mr. Ford, they asked me what it would cost to carry this to the 45-boat program, and I gave them the cost by year, and what we would have. This letter to the Secretary of Defense modified my letter and put it in package alternatives similar to the earlier committee request.

Mr. MAHON. Make all of this available to the committee in the hearings or otherwise.

(The information requested follows:)

My recommendations to the Secretary of the Navy with regard to augmentation of the POLARIS submarine program so as to obtain 45 SSBN's in an expeditious but orderly manner, are summarized below:

	Fiscal year 1960	Fiscal year 1961	Fiscal year 1962	Fiscal year 1963	Fiscal year 1964
SSBN		9	12	12	3
LLT		12	12	3	
SCN	$116.9	$765.4			
PAMN		50.6			
OPN		35.3			
R.D.T. & E	5.0	104.3			
O. & M	23.3	4.5			
Subtotal	145.2	960.1			
MCON		5.1			
Total	[1] 145.2	[2] 965.2	$2,344.5	$2,119.6	$636.2

[1] Addition required above present fiscal year 1960 funds.
[2] Addition required above $952.2 in President's budget now before the Congress.

1. This funding plan for a 45 SSBN program completely funds the initial investment cost (including the cost to develop a 2300 NM missile). This amount is $6,210.6 million in addition to the $3,694.6 million which has been programed to date including the fiscal year 1961 budget now before the Congress.

Admiral ENSEY. As the chairman directed, we conferred with Mr. Sanders and worked out a program that has an additional three, with long leadtime of three; an additional three, with long leadtime of six;

an additional six with long leadtime of six; and an additional six with long leadtime of nine. That is in the record. (See pt. V, p. 370.)

Mr. MAHON. When we determine whether or not we want to give consideration to this acceleration will we have all those facts before us?

Admiral ENSEY. Yes, sir.

Mr. MAHON. I do not think there is any use in exploring the matter further at this point, but I do want to make clear that one of the things I want to know for the committee is whether or not you have sufficient research and development money in your area of this budget for the POLARIS?

Admiral HAYWARD. I would make a statement on that because I went forward originally with money in the sum of approximately $84 million for increasing the range of POLARIS. I did this in the research and development area primarily because I am convinced that the POLARIS system is going to be here in the 1970–80 era, and the more ocean we have to operate from, the better off we are. It was deleted and I think I should have had that money and I so stated to the Secretary of the Navy and to the Secretary of Defense.

I still feel that way.

DEVELOPMENT OF LONGER RANGE POLARIS

Mr. MAHON. It seems to me that as early as possible we ought to have additional range for the POLARIS.

Admiral HAYWARD. Yes, sir.

Mr. MAHON. As I understand the implication of your testimony, funds are not included in this budget at this time to accelerate the program for extending the range of the POLARIS?

Admiral HAYWARD. That is correct. That was removed from the budget as it was submitted from the Department of Defense to the President, and to the Congress.

Mr. MAHON. Do you know why this money was deleted?

Admiral HAYWARD. No, sir; I do not.

I do not know, unless Admiral Ensey can tell us.

The Secretary deleted it, as far as I was concerned.

Mr. MAHON. When Dr. York was before us, he seemed to be quite enthusiastic about getting an additional 1,000 miles range for the POLARIS.

Which Secretary deleted it, Navy or Defense?

Admiral HAYWARD. The Secretary of the Navy, sir.

I lost that particular fight.

Mr. MAHON. Maybe your arguments were not sufficiently strong.

Mr. SHEPPARD. May I suggest to the chairman that it is rather difficult to argue against the Bureau of the Budget.

Admiral HAYWARD. It was a phasing as much as anything else. He felt that I was early to do this and that it was too early.

Mr. MAHON. You mean you may not have the capability of doing it, and you need more experience, or what?

Admiral HAYWARD. He wanted to wait 1 more year on this. I felt there was sufficient technical background to go ahead with it now, which Admiral Raborn felt.

Mr. MAHON. We do not have even one operational at this time. I can understand why some people want to wait a while.

Mr. LAIRD. Mr. Chairman, that question was asked of the Secretary while he was here, and he responded he would like to keep reviewing this. He thought some of the tests had not gone along as far as he thought they should for him to put his stamp of approval at the time of the budget presentation.

Mr. MAHON. Will you at this point in the record make reference to the place where this testimony to which Mr. Laird referred appears?

Admiral ENSEY. Yes, sir.

(Record of House hearings, DOD Appropriations for fiscal year 1961, pt. II, p. 90. Also see p. 73.)

Mr. MAHON. When do you plan to fire the first POLARIS missile from a submerged submarine?

Admiral HAYWARD. (Off the record.)

USE OF FISCAL YEAR 1960 ASW ADD-ON

Mr. MAHON. I think it would be well for us to discuss a subject in which the Navy, and certainly this committee, is very much interested; that is the subject of antisubmarine warfare.

In fiscal year 1961 budget that request is $180 million for research and development on antisubmarine warfare. The 1960 budget requested $175 million for this purpose and Congress appropriated an additional $45 million, as will be recalled.

Admiral Burke testified that the additional funds were apportioned and that you, Admiral Hayward, or someone else in your shop, would discuss the use of this money in detail.

Will you do that now?

Admiral HAYWARD. Yes, sir.

Generally, that $45 million is ASW add-on in the area, and it is broken down into four areas; under classification, detection, and localization, where we are going to spend $30 million of it. I will go into the actual number of projects and what they are related to, in detail.

For weapons ordnance and fire control, we will spend $6 million and for vehicle propulsion equipment we will spend $5.4 million, and for collateral support and related equipment, we will spend $3.4 million.

We are using this particular $45 million to fund the most urgent requirements which show the most promise of real advance that we could not fund under the other level.

Mr. MAHON. I got the impression from Admiral Burke that actually there has been some shadow boxing, shuffling about of funds. There was nothing really effective which had been done with respect to this $45 million.

Admiral BENNETT. Would you like to have the figures on obligations, unobligated, and so forth, out of the $45 million?

Mr. MAHON. Yes.

Admiral BENNETT. As of February 28, we showed a total of committed balance of $17 million, and uncommitted balance, which merely means that the paperwork has not gotten far enough along, about $26 million.

Mr. FORD. That is out of the $45 million?

Admiral BENNETT. Yes, sir.

Admiral HAYWARD. Just related to the $45 million.

Mr. MAHON. There has been very little expenditure of any on this?

Admiral BENNETT. Very little expenditure except that in some few of the areas where the money was referred to laboratories, which spends out at a fast rate, as much as 85 percent a year.

Mr. MAHON. Were other funds reduced and this $45 million more or less fitted into a pattern in such a way that the action of Congress would not be effective in producing acceleration?

Admiral HAYWARD. The answer to that is "yes." I was going to say that actually we are having a forced carryover of obligations of, roughly, around $50 million. What happened was, I was directed to carry over $50 million of my program into 1961.

This was my comptroller friend, not Admiral Ensey, but someone else. This delayed us, and I tried to fight against this, but I have not had much luck yet. I have to go back to the Department of Defense and ask them for authority to obligate that additional $50 million which they have withheld arbitrarily, to carry over into 1961.

Mr. MAHON. Did they withhold $50 million which is to be carried over into fiscal 1961, and give you $45 million, the net result being a loss rather than a gain?

Admiral BENNETT. That is not quite correct, Mr. Chairman.

To give the devil his due, if I might put it that way, this carryover can be committed but not obligated until after the first of the year. It occurs to me that the overall figures on the ASW program are probably as illuminating as any. I can give you the summary figures on that, if you would like.

Mr. MAHON. All right.

Admiral BENNETT. The total available in 1960, NOA, is just about $250 million, and of that there remains an unobligated balance of $116.9 of which only $48.8 is uncommitted.

This is in ASW.

Mr. MAHON. Admiral Yeager, I am not too happy about what has developed here. Would you add anything to the situation that might be illuminating?

Admiral YEAGER. You mean in the $45 million?

Mr. MAHON. Yes.

Admiral YEAGER. It is true what they say. We do have——

Mr. MAHON. What who said?

Admiral YEAGER. Admiral Hayward; that we have got so much committed.

In answer to your question, where you ask if this is a going program, there are only six new items that have come up in the ASW program. The balance has been on items in research. This money helps us continue and that is the important thing there for us. Admiral Hayward spoke a while ago that we have got this money now to continue the studies in detection, classification, and so on, and that if we had not had it, it would have hurt us.

Admiral HAYWARD. We had an awful lot of things happen to us this year, Mr. Chairman. We had this particular argument and then when they tied the 1960 and 1961 budget together we had that, and then we have decided we would put the Bureaus of Aeronautics and

Ordnance together this year; so we had that. We have had a real bad fall, or, let me say, an early winter.

To continue in answering what we did with this $45 million, I will submit for the record the actual projects that this was put on. It covers the Office of Naval Research, Bureau of Naval Weapons, both Aeronautics and Ordnance, and the Bureau of Ships.

(Classified information was provided the committee.)

Mr. FORD. Has that money been put on, or will it be put on, projects you did not contemplate before you went before the committee last year?

Admiral YEAGER. There were only six new ones and the rest were areas going ahead, but not funded as we wanted them.

Mr. FORD. You made up those difficulties with this $45 million?

Admiral YEAGER. That is right.

Mr. FORD. Or you plan to between now and the end of the fiscal year?

Admiral YEAGER. Yes; we do.

I will give you some good examples.

For example, on the Mark 46 torpedo, we put a million dollars on it, and all across where we could use this money we did it on going projects.

Mr. MAHON. Thank you, gentlemen.

We will reconvene at 2 o'clock.

AFTERNOON SESSION

Mr. MAHON. A few times in the committee we have discussed a research and development program called WAGMIGHT. I refer to page 147 of part 1 of the Defense hearings for this fiscal year. I believe you have someone here who might discuss that with us.

WAGMIGHT PROGRAM

Admiral HAYWARD. Mr. Chairman, I would like to make a comment about WAGMIGHT. I do not know how it came. I was the man who made the decision not to do anything about WAGMIGHT. Captain Bright here has the background on it. I testified before the Science and Astronautics Committee on this subject. I want it clearly understood it was my decision not to go forward with it.

I still think it is a sound technical decision and will stick by it. Captain Bright will answer any questions on it. I will give the reasons why I did not go forward with it.

Mr. MAHON. Captain Bright, how much money have we spent on this project and what is the present status of it?

Captain BRIGHT. Within the Navy we have not spent any money, per se, except that that you could count for the salary of the naval officers and civil service people who worked on the project.

The people who helped us from outside contractors came in on the basis of doing it as part of a study group at no cost to the Navy. They paid their own expenses.

Mr. MAHON. What is the general idea of the WAGMIGHT?

Captain BRIGHT. Mr. Chairman, it is an inflated missile-aircraft concept which is new to the weapons arsenal. I have with me a pres-

entation that takes about 20 minutes that gives you the complete rundown on the technological aspects of it and the operational aspects of it. In order to best acquaint you with the project, I would suggest, if we have the time, that we look at this.

Mr. MAHON. If you are not doing anything about it and do not propose to do anything about it, maybe there is no need for our doing this at this time. Why are you not trying to do something about it?

Captain BRIGHT. I am, sir. As a matter of fact, I left a meeting at the Bureau of Naval Weapons when I was called to come over here where we were conducting an evaluation of the findings of the WAGMIGHT missile-aircraft. These findings were to be reported to the Vice Chief of Naval Operations. This has been going on for the last 2 days.

I think I can safely say that in the last month in particular we have been very active in speaking with Dr. York's office on WAGMIGHT, with Admiral Hayward's office, and with the Bureau of Weapons technical people in particular.

Admiral HAYWARD. Mr. Chairman, my decision is not to go forward on this.

Mr. MAHON. Your decision is not to go forward at this time on it?

Admiral HAYWARD. At this time; yes, sir.

Mr. MAHON. Are you giving it further consideration?

Admiral HAYWARD. We will look at it, certainly, because, as you brought out this morning, which was very true, I have the job of being selective. We cannot go into vast projects with half vast ideas. I am certainly going to examine it and I said I would, but I have any number besides the WAGMIGHT that have fallen by the way. This will happen every year.

Certainly, we are going to consider it. Whether we would build an airplane with it is another question. We may use only part of it for structural material. We may do any number of things, but at the moment we are not going forward. It is not in the 1961 budget at all.

Mr. MAHON. Generally, what are the most patent reasons why you do not want to go forward now with WAGMIGHT?

Admiral HAYWARD. Because I do not believe the state of the art, as they say, is such that I can make a tactical aircraft packaged, as they say. We have done other work in ONR, on the inflatoplane and small aircraft, but in the large aircraft I cannot package too well some of the radar and other weapons systems I have.

The structure is relatively a small cost of the system nowadays. The airframe runs about 20 percent, whereas my radar systems, weapons, and the rest run a lot higher than this. It may have some very good use as structural material.

The Goodyear Co., which has backed this, has a missile contract from us, SUBROC. They certainly do not intend to use this structural material in that approach. I just do not think it is far enough along to make any decision of this kind. It is strictly in the research field. I certainly would not propose it, I do not think we know enough about it to say operationally that it can do anything.

As I say, this has been my responsibility in the Navy and I have made this decision on it, which is the reason I will not go for a system on it. I will certainly continue to look at it.

Mr. MAHON. What is the system designed to accomplish?

Admiral HAYWARD. One of the things which is outside of the business of the small aircraft is that if you could carry more aircraft in a certain space, this would have advantages. If you could use it as structural material, this might have advantages, too.

From the system point of view, it might be attractive. We have so many other parts of it besides the airframe. This is primarily concerned with the airframe, a way to make a structural material.

Mr. MAHON. Mr. Flood has just handed me a newspaper story which we have discussed here in the committee.

Admiral HAYWARD. Is that Drew Pearson's article?

Mr. FLOOD. No; this is a newspaper syndicated mocked-up picture and caption dealing with the WAGMIGHT.

Mr. MAHON. This is a newspaper story from a well-known and very important town, Wilkes-Barre, Pa. It has the pictorial presentation, "Bouncing Baby Missile Made of Rubber." I think we pursued this as far as we want to now. Next year you will have a better idea.

Admiral HAYWARD. I will have a lot more knowledge, I hope. I wanted to make sure Mr. Pearson and the committee knew it is not snarled in redtape. The real question was I said no on it.

Mr. FORD. Is your position supported by your staff or your advisers?

Admiral HAYWARD. Yes, sir; it certainly is.

Mr. FORD. Is your position supported by Dr. York and his people?

Admiral HAYWARD. I have not talked specifically with Dr. York on the subject. From the evidence I have, Dr. York is not interested.

Mr. FORD. That is all, Mr. Chairman.

Mr. SHEPPARD. Mr. Chairman.

Mr. MAHON. Mr. Sheppard.

Mr. SHEPPARD. Who is the originator of WAGMIGHT?

Admiral HAYWARD. I guess Captain Bright is one of them, Captain Wagner, and Adm. Henry L. Miller.

Captain BRIGHT. Mr. Chairman, this was created as a result of a study done in the Office of the Chief of Naval Operations and it came out of this study composed of a group of about 18 people.

I might say for the record that the reason I have been so interested in a project which, according to Admiral Hayward, has had a good evaluation but which he has laid to rest, is that in the summer of 1958 Admiral Hayward in a written letter backed the WAGMIGHT study for going forward with its development immediately, using fiscal year 1959–60 funds.

At that time his people made a study of WAGMIGHT and found it was feasible enough to go ahead and further, it had real promise. This was done in spite of the fact that the Bureau of Aeronautics had written an official letter saying you should not go forward with its development. Because of the guidance and leadership I got from Admiral Hayward, we have continued to move ahead in this matter. From then until now it has been a matter of trying to overcome opposition which all new ideas get, but in particular to try to get some action within the Navy and Dr. York's office.

Last summer Dr. York's people made an analysis of WAGMIGHT and stated to me that, if the Navy would come up with the require-

ment, they felt the money, which amounted to a sum of $3 million, could be supplied for this project. At this time we could not get the Navy to say there was a requirement, and the thing has stayed on dead center until January of this year. Having just come from the Bureau of Naval Weapons, I believe that one of the big problems Admiral Hayward mentioned, which was the packageability, has been solved. This feature is the one that seemed to be the one that everyone used to prove why it was not technically feasible or why we should not go ahead with it.

This objection has been set aside. The technical people say now it can be folded with all the equipments in, that it is technically feasible to go ahead with the development program and that we can realize a quantum jump in naval airpower if we bring WAGMIGHT into the fleet.

Mr. MAHON. You feel pretty optimistic about it yourself, personally, I assume; is that right?

Captain BRIGHT. Yes, sir; and I have been with it 2½ years. I am not the inventor. I was assigned a job to do. I feel it will do a great deal for the Navy now and in particular, it will increase the U.S. defense posture——

Mr. SHEPPARD. May I get an answer to my question, if you do not mind. So far the question has been only partially answered. I want to know: Who was the originator? Tell me that first.

Captain BRIGHT. I was project officer, and the group that did the study originated it.

Mr. SHEPPARD. Was all the group you were associated with military? This was a composition created through the minds of military bodies and under that circumstance the U.S. Government is the sole owner of whatever this WAGMIGHT may ultimately be; is that correct?

Captain BRIGHT. Yes, sir.

Mr. SHEPPARD. That is all I wanted to know.

Mr. FORD. What is the military requirement for this? What will it supplement or what will it take the place of?

Admiral HAYWARD. Out of my office comes all of the requirements for the Navy. I have no requirement for the WAGMIGHT as it exists today. The letter I went forward with was that I felt we should look at it; I wanted to look at one particular airplane, but I am not about to buy any system or write a requirement for it. I do not agree with Captain Bright that all technical problems have been solved.

As I complained about Dr. York being a project engineer, I am surprised that the House Appropriations Committee is a project engineer on WAGMIGHT. This was a decision, and I will stand by it, Mr. Chairman.

Mr. MAHON. We do not care whether you want to stand by it or whether you do not, but we owe it to our country and to the Navy to explore ideas which offer promise.

Admiral HAYWARD. Yes, sir.

Mr. MAHON. People must not get so set in their ideas that they think they cannot be wrong. I think even Mahon and Hayward could be wrong.

Admiral HAYWARD. Yes, sir.

Mr. FLOOD. Not very often.

Admiral HAYWARD. Thank you, Mr. Flood.

Mr. Chairman, what I am saying is I did not write a requirement which meant, just as I was telling you this morning, large sums of money for a large system. I will do my technical homework on this; I am not saying to forget it and closing my mind in any way. Nobody is. At the moment I have no requirement for the WAGMIGHT to take the place of the A–4D or A–2F or anything of that kind.

Mr. MAHON. You seem a little tender on this subject. You said you did not think the Appropriations Committee should be the project engineer on it. What have we done to make you think we are trying to be the project engineer on this?

Admiral HAYWARD. I am not tender on this. I have 50 officers who can come up and give you ideas such as WAGMIGHT. I have the Flat Fence, I have the Tepee. If you want to review those, fine. They are ideas. They are in the same stage as Captain Bright's idea is. They are all good ideas. We have 450 proposals from industry on how to find submarines. They are all good ideas, really, but to write a requirement—I must define a requirement. I have tried to make it clear this morning that our job in management is selectivity of these requirements.

We will do our technical homework on this. I am not prepared to say that you can package a J–79 or sling it around like he says, or a J–52. Maybe next year I will be able to and I will have a requirement. But we have many ideas and this is just one of them. That is why I wondered why you are not interested in the Flat Fence or one of the other ones.

Mr. MAHON. We are interested in all that are brought to our attention. We cannot explore all of your projects in detail so we choose certain projects for close study. We are interested in stimulating the Navy and other services to do the best possible job.

Admiral HAYWARD. Yes, sir; and we should.

Mr. MAHON. There has been considerable publicity given to this more or less revolutionary idea. We just are simply asking questions about it, which is certainly within our province, and which does not indicate that we are trying to be project engineers. We are not trying to tell you what to do or not to do, but here apparently is a man who has been sufficiently good to have four stripes on his arm and he seems to think there is something in this although you do not appear to think so. As between you and him, I would probably follow your judgment.

Admiral HAYWARD. Mr. Chairman, we have built these inflatoplanes. We have built a total, I think, of 10 of them. They are the low speed ones. We have done a lot of work on this particular idea. We have not made this jump at all. I am delighted that you want to listen to Captain Bright. He is enthusiastic, and he believes in it. It is fine. I think we should do our work on it.

Mr. MAHON. I think it is fine that you have different ideas. We do not regiment thinking in the Navy.

Admiral HAYWARD. We certainly do not.

Captain BRIGHT. Mr. Chairman, in that I was called up here to this meeting and since I appeared before the Science and Astronautics Committee, I have become, as you well imagine, highlighted in this project whether I like it or not. I would like to say in my own behalf

that, first of all, in answer to your question, there are requirements for WAGMIGHT. One is in antisubmarine warfare, which is for completion in 1960 and is signed by Admiral Hayward.

No. 2, I would like to read a statement I think you would like to hear because it states in a nutshell what the value of the study was. When I read that, I think it would be most meaningful so that either we could put it to rest or you would have the best possible feeling for its relative importance.

Mr. MAHON. We will place that statement in the record at this point if there is no objection.

Captain BRIGHT. It also has attached to it a description of the WAGMIGHT concept, which is unclassified, that might be of some value when people have questions, without talking to me. That should go with it.

Mr. MAHON. Thank you very much. We are pleased to have your views. They are very interesting.

(The statement and attachment referred to follow:)

PROJECT WAGMIGHT

Gentlemen, I am Capt. Cooper B. Bright, U.S. Navy, on duty in the Office of the Deputy Chief of Naval Operations for Logistics.

It is a pleasure and a privilege to appear before you today to present a new concept called the WAGMIGHT missile/aircraft. This concept has the potential of revolutionizing the defense posture of the United States, greatly increasing our capabilities in both limited and nuclear war while affording substantial savings in the defense budget.

It is my experience that nearly everyone who has seen the presentation of the WAGMIGHT concept has been impressed by the almost limitless range of application. This includes a relatively large number of Navy and Marine flag officers who agree with the conclusion that development and test of the WAGMIGHT concept should be carried out without delay, particularly in view of the wide variety of substantial advantages to be gained with a modest investment in money and time.

The key to the technical aspect of the WAGMIGHT system is the development and construction of inflated structures. Scientific and technical personnel concerned with the development of such structures state without reservation that this concept is well within the state of the art. They have concluded, after careful study, that prototype construction can be accomplished on schedule and that the sums involved are modest. It may be of interest that there has been no considered evaluation which has proven a single promise of WAGMIGHT to be unfounded. In fact, all detailed studies to date have supported the technological and operational findings of the WAGMIGHT study.

You no doubt have heard other plans described which will create an appropriate defense posture during the period 1962–65. Each case involves additional yearly expenditures of billions of dollars. In the case of WAGMIGHT I speak of an increase of our defense posture but with little or no increase in our defense budget. In essence, dual use is made of weapons systems which today serve but a single purpose.

This study recognizes that while technological advances in weapons are a fundamental requirement, the economic realities demand that the military and industrial scientist give appropriate attention to the economic and fiscal factors which these advances place upon the Nation.

From the Navy point of view alone, WAGMIGHT means greater utilization of the ships now in the fleet. In addition, these WAGMIGHT missile/aircraft could be deployed by our allies in all locations where there is sufficient water and land for launching it.

Although primary attention in the study has been given to the integration of the WAGMIGHT concept into existing naval forces, I am not unmindful of the significant contribution WAGMIGHT can make to the capabilities of the Army, Marine Corps, and Air Force.

In continuing my interest in WAGMIGHT, from March 1958 at the beginning of the study which produced the concept, until today, I have been motivated

by two forces; the first is an abiding devotion to the Navy, and the second, an unswerving belief that in WAGMIGHT there is the possibility of producing a weapon system which can insure the survival of the United States through a deterrent capability so invulnerable as to defy all attempts to significantly blunt it.

WAGMIGHT Missile/Aircraft Study

OBJECTIVES

This study conducted within the Navy resulted in the WAGMIGHT missile/aircraft concept had the following objectives:

(*a*) Nuclear striking forces must be created that could:

(1) Be so dispersed and concealed that any enemy would be denied the advantage of being able to launch a successful surprise attack on the United States and allied nuclear forces.

(2) Survive in such numbers following a devastating nuclear attack that the residual fighting force would be able to guarantee any enemy bases and forces would be completely destroyed.

(3) Be located so that they would not draw nuclear weapons on civilian population and industrial centers in the continental United States and overseas.

(4) Also be employed as limited war forces, while at the same time possessing sufficient retaliatory striking power to be a deterrent to all-out war.

(*b*) Limited war strike force must be created that could:

(1) Make possible airlifting amphibious elements in the ship-to-shore movements and satisfy the operational requirements for 1972.

(2) Also be capable of being employed as nuclear retaliatory forces.

(*c*) Could be produced in sufficient time to be deployed during the period 1962–65.

(*d*) Increase the offensive and defensive capability of the fleet against submarine, surface, and air attack without increasing the number of ships in the force.

(*e*) Provide for economies in construction, replacement, repair, and dual employment to make possible a sizable reduction in the defense budget.

GENERAL DESCRIPTION OF WAGMIGHT MISSILE/AIRCRAFT CONCEPT

(*a*) This study considered various configurations of WAGMIGHT missile/aircraft for different missions. One example of a particular type and mission selected for purposes of the study is a WAGMIGHT capable of low altitude tactical missions at high subsonic speeds. It has a wingspan of 20.9 feet, overall length of 39 feet, height of 11.2 feet, and weighs 15,500 pounds.

(*b*) It is a monoplane having two jet engines delivering a maximum speed of about 480 miles per hour at sea level. It is designed for a 110 miles per hour landing speed and has a 1,100-mile range.

(*c*) The aerodynamic shape of the wings, fuselage, and empennage is maintained by being inflated with 50 pounds of air pressure. The metal engine, instruments, landing wheels, and the plastic or metal cockpit section are the only rigid parts. This inflatable aircraft is ideal for naval use, as it can operate from land, ships, or from the water as a seaplane.

(*d*) The inflatable material of which WAGMIGHT is constructed, is manufactured by joining two layers of fabric connected by many nylon threads. This sandwich like fabric construction is called airmat. The size and shape that any structure forms when inflated is determined by the thread length.

(*e*) The inflated aircraft is far from being just a drafting board design as inflated aircraft are existent and operational today. Known as inflatoplanes, they have been tested in over 600 separate flights. These flights tests were conducted up to speeds of 87 miles per hour.

(*f*) An automobile tire is similar to the WAGMIGHT fabric construction and inflated structure. This commercial product in its daily use dramatically testifies to the endurance, reliability and long life of such structures under most severe conditions of heat, abrasion, and shock. Neoprene coated fabrics used in flexible conveyor belts, for handling gravel, iron ore, coal, and rock, etc., further attests to its use where long life must be assured under severe field operating conditions. Behind this product is research experience and manufacturing know-how dating back to 1900. This same industrial production with its

extensive research and development programs makes possible the early flight testing and subequent mass production of WAGMIGHT missile/aircraft.

(*g*) The foldability inherent in fabric construction, significantly reduces the space needed for stowage of WAGMIGHT when compared to metal airplanes. This is achieved without additional weight penalty.

FOLDABILITY

(*a*) The WAGMIGHT study determined that by employing pneumatic power transmission for actuating flight control elements the rigid rods and plumbing now used in metal aircraft could be eliminated. Also, by providing pneumatic suspension of equipment in the fuselage, the shock resistant and abrasion properties of inflated structures would allow for the elimination of many external fixtures now necessary for absorbing the shock of landing. Likewise, the equipment and plumbing necessary to allow for the wings to be folded would be greatly reduced. In addition, a study of the A–4D airplane conducted by Op-O9D and personnel from the Bureau of Aeronautics determined it could, with few modifications, be relatively easily packaged (including the fuselage) if constructed of fabric. Finally, because of the space aboard ship now designed to accomodate aircraft and missiles could hold many additional WAGMIGHT airplanes, it would be possible to substitute for multimissioned planes, ones designed for a specific military function. This would further reduce the equipments now required and allow for increased foldability of both wings and fuselage structures. The unique advantage to fold or compress the fuselage into a relative small package has been determined in this WAGMIGHT study.

These WAGMIGHT missile/aircraft would be able to withstand, without damage, impacts encountered in shipboard or ground handling that would permanently bend or dent conventional metal structures. Any distortion of the inflated aircraft in the form of wrinkles or buckles would be automatically corrected when the impact or pressure load is removed.

Temperatures of about 160° F. encountered at 450 miles per hour will not cause the fabric to burn. Inflatable material now commercially available can withstand up to 700° F. Materials available for research testing can withstand temperatures of 1,500° F.

One method utilizes compressed air taken from the jet engine compressors to maintain the inflated pressure if the structure was ruptured.

Repairs such as a major break in the surface of a wing could be easily remedied by applying patches much the same as are used on automobile tire inner tubes. The same repair in a metal aircraft would require removal of the component, such as the wing, and application of welding, riveting, and sheet metal shopwork.

Salt water corrosion, which has long been one of the great detriments to seaplane operation, would disappear with the introduction of fabric construction. These aircraft would be able to spend extended periods of time in the water.

The fabric surfaces of WAGMIGHT missile/aircraft do not reflect radar, only the metal components will contribute a radar image. To determine the value of this advantage, a fabric aircraft and a conventional aircraft (metal) were programed in attacks against a defense system. The result was a sizable decrease in the capability of the defense system to destroy a WAGMIGHT, as compared to a metal aircraft.

By using different kinds of fabric material in the same inflated structure, it is possible to vary its shape by changing the internal pressure. With this capability, a wing could be designed to change its cross section and provide integral control surfaces by merely varying the inflation pressure. The development of this principle would result in a combined vertical takeoff (VTOL) and short takeoff (STOL) capability for the WAGMIGHT missile/aircraft.

This new type aircraft also embodies the advantages of high speed, long range, plus packaging. This is especially applicable to the requirements of the amphibious forces in meeting the increasing demands of limited war.

It is possible to start today with the design of a subsonic (100 to 425 kilotons) WAGMIGHT aircraft and complete its flight testing within 1 year. Further, if production is desired, 300 aircraft a month could be delivered starting in 12 months from the completion of flight test.

The technical feasibility of the WAGMIGHT missile/aircraft was established, followed by an extensive operational analysis. This analysis determined that the increase in offensive and defensive capability, both as a force for deterring nuclear attack and meeting limited war situations, could result from its introduction into the fleet.

To establish some idea of the increased strike and defense capabilities the employment of WAGMIGHT gives to the fast carrier task forces, the U.S.S. *Forrestal* was selected for study. This aircraft carrier has aboard over 80 assorted aircraft for nuclear strikes, for support of amphibious landings, in defense of the fleet, and for antisubmarine warfare. By substituting WAGMIGHT's for conventional metal airplanes and utilizing only 50 percent of the hangar deck space, 1,000 aircraft could be packaged and accommodated aboard.

To carry sufficient pilots to man this large number of aircraft would not be desirable. However, one must remember that many could be used as one-way missiles. Further, this number would provide a reserve from which to resupply all the other ships in the fleet. These numbers demonstrate the significant increase in aircraft and missiles that can be deployed not only from aircraft carriers, but from all the ships now in the fleet. This represents a dramatic increase in the U.S. Navy's offensive and defensive capabilities.

For illustration purposes, assume we increase the present carrier load to between 100 and 200 aircraft. This number would make it possible for all the aircraft required to strike land targets to be launched and proceed to the targets simultaneously. This would greatly reduce the time the U.S.S. *Forrestal* would have to survive from enemy attack in order to launch all its atomic strike aircraft. Such an increased number of WAGMIGHT aircraft aboard a carrier would enable one carrier to do the job that today is required of two.

With the increased number of aircraft aboard carriers, we could plan for airplanes built for one type of mission (fighter, bomber, etc.), with the minimum equipments and controls as was the case at the start of World War II. This reduction in the complexities and numbers of equipments and components that are now carried in each multipurpose aircraft would make possible a high degree of foldability in WAGMIGHT's.

To determine what advantage the application of the WAGMIGHT concept will have on ambhibious war now and in 1970–75, the U.S.S. *Thetis Bay* was selected as a test ship. This ship now carries about 40 helicopters for air transport of troops to the landing areas. Again, utilizing only 50 percent of the hangar deck space, it would be possible to accommodate 145 WAGMIGHT's. However, these WAGMIGHT's would be capable of ranges exceeding 500 miles, have vertical takeoff and landing capabilities, and could attain speeds of over 300 miles per hour.

These WAGMIGHT's, launched or catapulted from the ship with maximum loads, would proceed to shore, make vertical descents in the landing areas at high speed, and depart by vertical or short takeoffs for return to the ship.

Additional important advantages accrued in utilizing this concept: Strategic planning can include the natural water areas of the world such as swamps, lakes, rivers, etc., for use as landing fields as each WAGMIGHT is a seaplane as well as a landplane. Major aircraft repairs can be made quickly and completely on the battlefield. These aircraft, which can be deflated upon landing ashore, can be hidden by taking advantage of the natural terrain. Parachute delivery of WAGMIGHT missiles and aircraft can be made to troops in the field. They can also be transported over land and on trucks, trailers, and jeeps as airpower organic to the Army and Marine ground forces.

Resupply within the fleet can be by airlift. As an example, the U.S.S. *Wrangell*, an ammunition ship, can carry over 50 WAGMIGHT-type aircraft abroad without reducing the total cargo of ammunition. These aircraft can make air delivery of atomic weapons, missiles, etc., to other ships and troop detachments ashore. Not only has a new method been fashioned of resupplying our troops ashore and ships of the fleet, but these supply ships could utilize these same WAGMIGHT aircraft and missiles to deliver weapons directly to the targets. Likewise, these aircraft could in turn conduct visual, radar, and sonar searches in defense of the fleet against the submarine threat.

WAGMIGHT missile/aircraft can be accommodated aboard the submarines now operating with the fleet while also carrying torpedoes. Each WAGMIGHT armed with a nuclear warhead will give to the present submarine force, a striking capability that will of itself be a major reason for deterring an enemy from launching a surprise atomic attack. This force will be unique because of its freedom from detection.

These same aircraft could be used for air early warning, reconnaissance, and for obtaining resupply from distant bases. It is realized that this concept will introduce many operational problems to submarines not originally designed to carry them; problems that will have to be solved by actual train-

ing operations at sea. However, in the case of the U.S.S. *Tunney*, a REGULUS missile-carrying submarine which accommodates a few missiles in a tank located on deck, it is possible to accommodate about 20 WAGMIGHTS. The few submarines equipped with these tank conversions now in the fleet will constitute a very significant nuclear striking capability with which an enemy will have to contend.

Let us go one step further and consider the submarine U.S.S. *Grayback*, which was built to accomodate REGULUS-type missiles inside the hull. This submarine could operate over 60 WAGMIGHTS. When you realize that the *Essex* class aircraft carrier has less than this number of airplanes aboard, you are, in fact, considering a submarine aircraft carrier that could join the fleet in a relatively short period of time.

Cruisers, landing ship docks and destroyers are examples of how WAGMIGHT missile/aircraft could be operated from all the ships of the fleet. Without any alterations, our present missile cruisers could carry and operate these missiles and aircraft for offensive nuclear strikes, air defense of the fast carrier task force, air early warning, as units in antisubmarine warfare and in the support of amphibious landings. The landing ship dock could bring into the well deck, which is flooded with water, the airplanes which have landed in the sea. In addition, the flight decks now installed for carrying helicopters are adequate for WAGMIGHT aircraft launching and recovery operations.

Perhaps, of real significance is the nuclear retaliatory force that could be created by operating five WAGMIGHT aircraft from each destroyer. Today they constitute the largest number of any one type of combatant ship dispersed over the oceans of the world. This type missile/aircraft made principally of coated fabric components is particularly well suited for employment in the difficult rough weather conditions associated with destroyer operations.

To summarize, let us consider how completely the WAGMIGHT concept has satisfied the objectives of the study:

NUCLEAR STRIKING FORCE

Deployed from all the ships and submarines now in the fleet a mobile nuclear striking force will have been created which could be so dispersed and concealed that any enemy will be denied the advantage of being able to launch a successful surprise attack on the United States and Allied nuclear retaliatory forces. Such a force could deploy its retaliatory WAGMIGHT missiles and aircraft concealed in submarines under the sea, aboard ships dispersed on the seas and when required in airborne alert status.

Let us assume the enemy will be able to determine the exact location of all our surface ships and thus be able to destroy them with a surprise nuclear attack. The remaining WAGMIGHT equipped submarines could constitute a cohesive fighting force capable of completely destroying the attacker.

The allied ship and submarine based nuclear retaliatory forces would divert enemy nuclear attacks from civilian population centers and industrial locations in the continental United States and overseas.

Of real importance is that those WAGMIGHT missile/aircraft based aboard ships and assigned for providing a ready force to deter all-out war can, at the same time, be utilized in meeting limited war situations. This dual-purpose employment will permit meaningful reduction in defense spending.

Between 1962 and 1965, the missile capability of the United States and Allied nations can be significantly increased as WAGMIGHT missile/aircraft can be produced in sufficient number by that time if development and production is started now. Producibility is one of the real advantages that makes inflated fabric structures so attractive as a weapons system.

LIMITED WAR FORCE

In limited war situations, WAGMIGHT aircraft deployed in the fleet allows for rapid airlifting of amphibious elements from ships dispersed along a wide front.

The capability of each ship in the fleet to counter the threat of submarines to amphibious landing would be increased manyfold.

The offensive and defensive capabilities of the fleets against submarines and air attack in both all-out and limited war will be increased manyfold without increasing the number of ships.

The savings in cost comparing only the structural shell of a metal airplane and a fabric structure, although less for fabric, were not meaningful considering the total value of the airplane. In fact, it was only when mass production was considered that this particular item began to increase its cost advantage. However, these savings when added to the cost of equipments that could be eliminated when fabric construction is employed, as compared to metal, land or seaplane, the cost advantage in favor of WAGMIGHT become meaningful. However, the real saving in money would be realized from a reduction in the cost of our present defense system. Today, the defense budget provides for strategic deterrent bombers and their bases. In addition, we support separate forces utilized in limited war. With the WAGMIGHT missile/aircraft deployed throughout the fleet, it would be possible for the aircraft used in limited war to also be employed for delivering nuclear weapons in general war. Likewise, the same bases (ships of the fleet) will be supporting both efforts which today requires separate base complexes. Finally the ships of the reserve fleet which are ready for deployment can be used if the requirement should excede the capability of the ships now in the active fleet. It is obvious the possible savings in the yearly defense budget would be most meaningful to say the least.

CONCLUSIONS

The extensive and detailed study of the application of inflated fabric structures to missile and aircraft construction has established the technical feasibility of the WAGMIGHT concept.

The objectives of the study could be satisfied with the deployment of WAGMIGHT/aircraft in the fleet.

To benefit from this revolutionary advance requires first; accepting the introduction of a wholly new technology that changes established military strategic concepts and tactical operations; and second, requires the decision to proceed immediately with the design construction and flight test of the WAGMIGHT missile/aircraft.

ANTISUBMARINE WARFARE RESEARCH AND DEVELOPMENT ITEMS NOT FUNDED

Mr. MAHON. We were discussing antisubmarine warfare earlier today. Some reference was made to a proposed $19 billion requirement for the Navy for fiscal 1961. This, of course, never acquired any official standing in the Bureau of the Budget. Admiral Burke referred in the $19 billion field to $200 million worth of high-priority ASW items of which one-half, $100 million, was for ASW, R.D.T. & E. Now could we have a list of those high-priority projects involving about $100 million?

Admiral HAYWARD. Yes, sir. I think he put them on the record then, Mr. Chairman. I am not sure. If he has not, I will put them on the record.

(A classified list of ASW R.D.T. & E. additional requirements was provided to the committee during Admiral Burke's testimony. (See summary of these requirements at p. 74 of pt. 2 of "House Hearings on Department of Defense Appropriations Hearings for Fiscal Year 1961.")

EMPHASIS PLACED ON ANTISUBMARINE WARFARE

Mr. MAHON. We need a sufficiently detailed statement for the committee or for the record so that we may understand the real work that might possibly be done in this field. In the Secretary's statement, which was presented earlier, it was declared that ASW was second only to POLARIS on the Navy priority list on research and development. How can this be a fact if you have not budgeted funds for $100 million worth of high-priority projects in this field?

Admiral HAYWARD. We have $180 million in ASW R. & D. This is like the rest of it. It was the decision, a balance of the systems to support what we were trying to do. I felt it was within the confines of the budget guidance I had been given for R. & D., that it indicated a reasonable program, was a good program. I think under the circumstances it was as good as we could get out of the funds available.

As an example, most of our effort was in the classification, detection, and localization and weapons ordnance and fire control. That was the greatest percentage of it. I felt we had struck a balance as good as we could in the program.

Mr. MAHON. In reviewing your project list one wonders why you think projects like dental research—we have had dental problems always and we will always have them and we should do some dental research—why projects like dental research, motivation morale, group effectiveness, food service operation, and operational analyses are more urgent than antisubmarine warfare.

Admiral HAYWARD. Operational analysis is part of ASW warfare. You have to analyze what your systems actually do. It is a hard decision but you cannot stop all your research in the dental business. You have what I think is a reasonable program that we have arrived at.

Another thing you have in ASW is that there are a lot of things you do outside of that $180 million that are applicable to it. Miniaturization of components, materials, radar, all your radar work, your electronic and magnetic, the whole subject.

NEED FOR DENTAL RESEARCH BY NAVY

Mr. MAHON. That is all very interesting, but I would like to get your reaction. We have thousands of dentists. We have dozens of dental schools. The question of dentistry is not peculiar to the Navy. If you have high priority items in antisubmarine warfare that you are not funding, how can you defend applying funds to a thing like dental research? I do not quite understand it even though the sum involved is not large.

Mr. MINSHALL. Mr. Chairman, how much is it?

Admiral GALLOWAY. $177,000 to dental research navywide.

Mr. MAHON. Why did you not take that and apply it to something that was probably more important? Many civilian organizations are working to some degree on dental matters.

Admiral GALLOWAY. Mr. Chairman, we have a major problem in the dental care of recruits. Much of our dental research is directed to preventing caries and reducing the total workload of recruit dental care.

(The following additional statement was submitted.)

Funds for dental research in the Navy are used to help prevent dental disease and to increase the amount and quality of dental treatment to all Navy personnel. The survey of dental health conducted by the U.S. Naval Training Center, Bainbridge, Md., in 1956 on naval recruits revealed the following:

(*a*) 93 percent had carious teeth (one or more).

(*b*) 38 percent required extractions (one or more).

(*c*) 67 percent had missing teeth at time of entry into the Navy (one or more).

(*d*) 79 percent had some form of gingivitis.

(*e*) 15 percent had malocclusion.

(*f*) 25 percent had poor esthetics (disturbance of appearance that was very undesirable).

This creates a dental workload of such magnitude that only a small percent of complete dental care can be provided. Basic research conducted by the Dental Corps is designed to reduce and prevent dental disease. Clinical application of dental research is designed to increase the amount of dental treatment to Navy personel and to render a better type of treatment. Two examples are (1) development of the air turbine handpiece which has been universally adopted by both the military and civilian profession, (2) improvement in the efficiency and adaptability of dental equipment for field use with the U.S. Marine Corps. There will be a constant increase in the amount of untreated dental disease unless new methods of preventing dental disease can be found. The public and private expenditures for dental research are woefully small compared to the magnitude of dental disease.

Mr. MAHON. Is not civilian medicine and the Public Health Service working in this field?

Admiral GALLOWAY. They are, sir.

Mr. MAHON. As I said this morning, under the cloak of research and development we are probably doing a lot of things that if we could only bring them out and expose them to the clear light of the noonday sun could not be defended. We talk about high priority projects needed to save the Nation. Antisubmarine warfare is a matter of life and death and yet you just could not stop dental research when it is a duplicative effort, no doubt. That is what undermines one's confidence in the management of this research and development program, Admiral Hayward.

Admiral HAYWARD. It is a very hard decision, Mr. Chairman. I think people who say that because of ASW you should do away with all other research——

Mr. MAHON. Nobody advocates that, but curtailment of research with a lower priority should certainly be considered.

Admiral HAYWARD. A lot of research with lower priority suffered completely and was stopped. Actually, I do not know. Maybe Dr. Galloway can tell me what they originally came in with on dental research, but I am sure they got less then they requested. BuMed did not come in for $117,000, they did not ask for that much and get that much, I can assure you.

Admiral GALLOWAY. I do not have that.

Admiral HAYWARD. I recall the figure as being close to around $250,000. I will furnish it for the record.

(NOTE.—The original request was $169,000.)

We pared it right to the bone without practically doing away with it completely. That happened across the board and was the subject of considerable debate and argument. It went right down to such things as you heard Captain Bright talk about WAGMIGHT. You will hear of proposals Admiral Bennett has that we did not fund. You will see areas where we have come down in missiles and everything else. These were the things we did. They were quite drastic in quite a few cases.

Mr. MINSHALL. Will the chairman yield?

Mr. MAHON. Yes.

Mr. MINSHALL. I think it would be appropriate at this point in the record to show whether or not the Army and Air Force have research in dental matters as well.

Admiral HAYWARD. Sure they have.

Mr. MAHON. There should not be any doubt about that.

Mr. MINSHALL. It would be well to know what they are spending as well.

Admiral HAYWARD. I am sure it is more than $117,000.

Mr. MAHON. Will you see that that information is furnished for the record at this point. I made my point, and I think it is a good one.

(The information to be supplied follows:)

Dental research, fiscal year 1961 budget

Army	$400,000
Air Force	60,000
Navy (BuMed)	117,000

ATLANTIS PROJECT

Mr. MAHON. One of the ASW projects not funded in fiscal 1961 is called Atlantis. What is this project and why is it not funded?

Admiral BENNETT. The money which is now available will be used. We just reviewed it yesterday, as a matter of interest, not connected with these hearings at all, but as part of Dr. Wakelin's review of status. The money available is about $10 million and is being used to determine the factors which are yet unknown about this system.

This is nothing off the shelf. There has to be considerable applied research, to put it mildly, to be sure where we are going before we go all out for a system of surveillance by this particular idea. We will not know what the results of the work which is now being undertaken will be until about January of 1961. This means we do not know what moneys should be programed for prosecuting this one further.

I believe that if the results justify it, we will be able to do something about it, but we simply cannot tell you now.

Mr. MAHON. That is a good answer.

Admiral HAYWARD. For the record, I should define what Atlantis is.

Mr. MAHON. Yes.

Admiral HAYWARD. "The Atlantis Project" is a report submitted by a group that the Navy got together headed by Leland Hayworth of the Brookhaven National Laboratory to look at the ocean area surveillance problem.

The Atlantis report indicated a large number of approaches, which may be taken to provide ocean area surveillance. The final overall ocean surveillance system, due to differing oceanographic and topographic features, is not the same—Would not be the same in the Atlantic as in the Pacific. We are devoting a million dollars on this comprehensive and competent systems study on the Atlantis report to see, as Admiral Bennett said, what we actually should do. Dr. York has indicated to me he will give us the money to go ahead with this at the rate we feel we can from the state of the art.

Mr. FLOOD. What about RAMOS and JULIE and ARTEMIS?

Admiral HAYWARD. JULIE is an active localization system used from fixed wing aircraft. ARTEMIS is a surveillance system and we are going ahead with it. Atlantis is a generic term for a study of this whole problem. It is not one particular system or idea. It covers everything from the use of portable buoys in the barrier to

the use of cable laid with transducers in it, an active system. It is the overall surveillance problem.

Mr. FLOOD. The Navy is to control the seas and that means underwater surveillance, submarine against submarine.

Admiral HAYWARD. This is correct, Mr. Flood, and it involves three things: the passive type, whether it is fixed or mobile; active type, whether it is fixed or mobile; the passive and active types from the submarine itself; and also the type systems you use from fixed wing aircraft; and also the systems you use from surface ships.

Mr. FLOOD. We do not want to get so enamored with POLARIS that we are forgetting about submarine warfare.

Admiral HAYWARD. We are not, Mr. Flood.

Mr. LAIRD. Will the gentleman yield?

Mr. MAHON. Yes.

Mr. LAIRD. It seems to me in that add-on list the committee was supplied you had $35 million in there for Project Atlantis.

Admiral HAYWARD. This is correct.

Mr. LAIRD. From your statement that has just been made here, it would seem to me that this is not a proper add-on.

Admiral HAYWARD. Mr. Laird, as a matter of record, last year I went forward to the Department of Defense asking for $75 million to do our work on the Atlantis Report. After we looked at it and saw the various aspects of it from the portable buoy, from the cable laying and the rest of it, we thought $35 million was a better estimate. We did not get any of that money in the emergency fund, incidentally. On the add-on list $35 million is a good figure as to what we would do in 1961.

Mr. LAIRD. You have the money carried over from 1960 which will be expended in 1961. I want to know how firm that $35 million figure is in the add-on.

Admiral HAYWARD. It is very firm.

Mr. LAIRD. You would expend that amount of money on Project Atlantis?

Admiral HAYWARD. In 1961.

Admiral BENNETT. I believe Admiral Hayward will agree with me, if investigations prove it is worthwhile.

Admiral HAYWARD. Yes, we are going to do that.

Mr. LAIRD. In response to the chairman's question you put some "ifs" on that. Your particular answer certainly did not justify the add-on list in the priority that we were given in an earlier submission before this committee.

Admiral HAYWARD. The Bureau of Ships is the lead bureau on this and has come in for a plan for implementing Atlantis which covers the whole surveillance business, not just one item. Captain Fahy is here and can talk in detail about the Bureau of Ships' plan on this. I think $35 million is a valid figure.

Admiral MOORE. I am Admiral Moore. Captain Fahy can talk on this in more detail.

Our present plan is expenditure of $10 million in fiscal 1960 and $42.5 million in fiscal 1961. As Admiral Hayward pointed out, this is an extremely complex problem. A lot of work has been done by the Atlantis group, but they have not firmed up, they just came up with conceptual ideas.

Mr. LAIRD. Are you not making a mistake talking about expenditures?

Admiral HAYWARD. Obligations, not expenditures.

Admiral MOORE. That is right. These funds have only recently become available and, of course, we are proceeding with the letting of contracts to the extent of the $10 million we are talking to now.

A lot of this, we have to go back and take conceptual ideas and really engineer them into something that makes sense, as was pointed out, depending upon what you are putting it in, the kind of coverage you want, and what have you.

Admiral HAYWARD. I apologize, I meant obligations. I did not mean expenditures.

Admiral MOORE. Captain Fahy can give you the particulars on just what is programed for this.

Mr. LAIRD. I will go into that when I get my turn.

ASSAULT TRANSPORT VTOL AIRCRAFT

Mr. MAHON. Are the Navy and Army going to undertake a joint program to develop an assault transport VTOL aircraft? If you both require such an aircraft, it would seem that it would cost the taxpayers less if you go into this together instead of each going his own way.

Admiral HAYWARD. Mr. Chairman, this is correct. We have already gotten together with the Army. When this budget went forward and the President's budget was printed in November and December, we had a requirement for this assault transport, we have gotten together with General Trudeau of the Army and General Binney of the Marines, and we are coming together with a requirement that will make sense for both of us.

You must remember in the VTOL and STOL there are various things. You want it to do the Marine and Army job, the Tactical Air Force and Navy job. Dr. York has gotten a group together with his people and ours.

Mr. MAHON. Will you please expand that for the record. I think there is something very important here and I believe the program should be pushed very energetically.

Admiral HAYWARD. Yes, sir; it is very important, and we are getting together with the Army, we have gotten together with the Air Force on the tactical airplane. We are writing our requirements so that we will develop the same engine sizes because it is an engine that is the heart of this.

Mr. MAHON. Will you amplify this matter at this point in the record.

Admiral HAYWARD. Yes, sir.

(The following statement was submitted:)

When this budget was prepared, and the President's budget was printed in December, the Navy was preparing to hold a design competition in January 1960, to develop a specific improved VTOL aircraft for the Marine assault transport mission.

Concurrent with these plans during October, November, and December 1959, a DOD sponsored ad hoc group for the evaluation of V/STOL aircraft, under the chairmanship of Prof. Courtland D. Perkins, was conducting meetings to study current V/STOL research projects and recommend a sound and economically feasible V/STOL program designed to best fulfill all existing service

requirements. In addition, the Army decided to separately conduct an extensive study program of their aviation requirements. The entire aviation industry was invited to submit certain studies designed to aid the Army in determining their R.D.T. & E. long-range direction. Particular emphasis was to be placed on the study of V/STOL assault transports, observation, and reconnaissance vehicles. The Air Force and Navy participated in this Army study. A presentation on the Marine VTOL assault transport, observation, and reconnaissance requirements was presented by General Binney to the Army study board.

Since it was evident that the Marine VTOL assault transport program would be both extensive and expensive, it was decided to postpone a design competition pending receipt of the recommendations and results of the Perkins committee and Army study groups.

The Army has just completed and published its report on March 10, and the Perkins committee findings are now in preliminary draft form. With these results and recommendations in hand we are now planning to go ahead with a VTOL R.D.T. & E. program which investigates areas of down-wash effects from various V/STOL configurations, stability and control, noise level, and other factors affecting the operational suitability of the several versions of VTOL craft, which previous research has found to be technically feasible.

In this area the Navy has been developing the Kaman H–168 tiltwing test bed program and full scale wind tunnel tests at Ames Laboratory are scheduled early this summer. We are closely monitoring the large Air Force Hiller X–18 tiltwing test bed presently being evaluated at Edwards AFB. All future R. & D. V/STOL planning is being very closely coordinated with the DOD, Army, and Air Force in the hopes that out of these efforts will come machines that can satisfy Army, Navy, Air Force, and Marine requirements.

The DOD has just formed a new V/STOL advisory ad hoc committee composed of working level representation from the Army, Navy, and Air Force to develop a joint long-range program to (1) meet service V/STOL requirements, with particular emphasis on guidance for the 1961–62 period; (2) provide continuous evaluation of the various services V/STOL research programs, and dissemination to industry, and; (3) prepare feasible procedures to handle joint service V/STOL aircraft projects.

In the past, 1957 through 1959, we joined hands with the Air Force in the jointly funded V/STOL tactical fighter weapons system, the Bell D–188A. This development was discontinued in March 1959 but is an area which will be reviewed as the state of the art improves and suitable propulsion plants are developed. The development of lightweight, higher thrust engines must precede successful V/STOL combat aircraft development.

The Navy has funds programed in the high-thrust engine area and the Bureau of Weapons is closely coordinating its efforts with the Air Force lightweight, high-thrust engine component developments presently underway at Pratt Whitney and General Electric.

MARINE CORPS ARTILLERY SYSTEM

Mr. MAHON. What is the Marine Corps artillery system for which you are requesting funds? Is this planned to modify some old guns or is it a study in the field of missiles, or what?

Admiral HAYWARD. I would rather turn this question over to General Hochmuth of the Marines, who is prepared to speak to the artillery system.

General HOCHMUTH. This is a joint Army-Navy-Marine project of the 115-millimeter boosted rocket.

(Discussion off the record.)

General HOCHMUTH. This gives us some additional range. We are hoping for a light gun mount. The 105 weighs something in the neighborhood of 5,200 pounds. We want something in the weight of about 3,000 pounds.

Mr. MAHON. How much money do you propose to obligate or spend in this program?

General HOCHMUTH. About $2.6 million, sir.

Mr. MAHON. How long has this program been progressing?

General HOCHMUTH. About 2 years, sir.

Mr. MAHON. How much will the whole program of research and development, test, and evaluation cost?

Admiral HAYWARD. The total estimated cost in research and development to complete is $6,387,000. The first year it was funded was in 1957.

Mr. FLOOD. What is the relationship of this instrument to the fact that you do not have LACROSSE? You have dropped LACROSSE.

General HOCHMUTH. That is correct.

Mr. FLOOD. What has this pigeon got to do with that?

General HOCHMUTH. This is the close support system. The shell weighs around 50 pounds.

(Discussion off the record.)

NAVY SPACE PROGRAMS

Mr. MAHON. Let us give consideration to the Navy space program. I have a United Press International story quoting you, Admiral Hayward, which says:

Admiral Hayward, Navy Research Chief, said yesterday that research on manned aircraft is going down the drain because of emphasis on space work.

Admiral HAYWARD. That is correct, Mr. Chairman.

Mr. MAHON (continuing).

He said invaluable work formerly performed by the National Advisory Committee on Aeronautics has been sharply curtailed since the agency was absorbed by the new National Aeronautics and Space Administration. Hayward also told the House Space Committee that all space development ought to be under a single military boss, but he said he shudders to think of another space reorganization now.

Admiral HAYWARD. That last part is not correct, Mr. Chairman.

Mr. MAHON. You mean about the shudders?

Admiral HAYWARD. The shuddering was right, Mr. Chairman, but I stated that you could run it either the way Medaris had said or the way Pickering had said. You could run it either that way or run it the way the administration has it. I said there was not much difference in the two proposals.

Mr. MAHON. Why is the Navy getting in the space field if someone else is already in it and it ought to be under one head?

Admiral HAYWARD. We have a great deal of interest in space. All you have to do is look at the globe again and note that 70 percent of it is water.

As I said before, last year, space is a place, not a program, with us. We are trying to do things in space that will permit us to do our job better on the sea.

Mr. MAHON. I think we would agree that the Navy is interested in space and has a right to be interested in space.

Admiral HAYWARD. You will find very little money associated in the 1961 budget with space projects primarily because ARPA had this responsibility in the Department of Defense. We are now actually running the "Dark Fence"; we are going to take over TRANSIT, the navigational satellite, from ARPA, which will permit us to navigate the sea by using space vehicles or a space satellite system.

Take the SATURN booster and things of that kind. You may have to launch this from the sea. You cannot afford to lose the first stage booster every time you launch; it is too expensive. A sea-based launch site does not need large fixed installations and you can launch into any orbit. We are interested in intelligence from space vehicles for all kinds of reasons. We are interested in communications, navigation, and we are also interested in the weather. Strange as it may seem, the Deputy Secretary of Defense gave the weather satellite and the passive communications satellite to NASA. Yet, we in the Navy are vitally interested in it and are using passive space communications by using the moon as a relay. We have a very valid interest in space.

Mr. FLOOD. If you are going into space, I did not know you were going that far on the element of propulsion. Do you have anybody here doing R. & D. on metals?

Admiral HAYWARD. We have quite a bit on materiel.

Mr. FLOOD. How about cesium and ribidium for thrust?

Admiral HAYWARD. In my testimony I said we should have one national space exploration program. We are not in the space exploration program. We do not intend to explore Venus or Mars. We are attempting, in the Navy, to use space to do our job better in the atmosphere.

Mr. FLOOD. You are interested in thrust?

Admiral HAYWARD. Definitely.

Mr. FLOOD. What I am talking about is utilization of these exotic metals like cesium or ribidium for the purpose of thrust beyond ICBM range into the space area, whatever your target is. What are you doing with these things? Do you have a minerals research program? Are you doing anything about these specific metals that I mentioned?

Admiral BENNETT. I do not believe so. Other people are doing this and we are watching.

Admiral HAYWARD. We are not, to my knowledge.

Mr. MAHON. In the confidential justification book on page C–41 four space satellite projects were discussed for which $1,272,000 is budgeted for fiscal 1961. Why does the Navy want these projects? It looks like the effort concentrated in ARPA, NASA, and elsewhere might be adequate. We, of course, recognize the importance of space to the Navy.

How much will each of these projects cost in the next 5 years if they are allowed to grow, and does the Navy feel that this is the best application that could be made of the funds involved? You may provide the answer for the record.

Admiral HAYWARD. Yes, sir.

(The information is classified and has been supplied for use of the committee.)

TRANSFER OF SPACE PROGRAMS FROM ARPA

Mr. MAHON. Mr. Ford had a question.

Mr. FORD. Are any of the space projects which the Navy is undertaking duplicated by space projects either in ARPA or NASA?

Admiral HAYWARD. No, sir; Mr. Ford.

Actually the greater portion of them have been done in cooperation with ARPA and NASA. For instance, in the centrifuge at Johnsville, which is in the biomedical environmental business, we have worked with NASA, ARPA, and the Air Force. Scott Crossfield has

flown thousands of times in our human centrifuge and it has been primarily funded up to now at a very small amount, as you see. The TRANSIT system has not been in the Navy budget since we have been doing this project for ARPA.

Mr. FORD. You do it on a contract basis more or less?

Admiral HAYWARD. That is correct. Johns Hopkins Applied Physics Laboratory is doing the job for ARPA. ARPA does not have the tools to do it except through us and that is why this particular item shows as it does.

Mr. FORD. There is nothing harmful in having this kind of a setup with the people who have a great interest in pushing it to the maximum, in this case yourselves or the Navy?

Admiral HAYWARD. That is right. We are doing that and ARPA, as you know, is now under Dr. York. ARPA is in the process of transferring space systems to the services and they have already transferred MIDAS, SAMOS, and DISCOVERER to the Air Force. TRANSIT is coming to the Navy and the NOTUS is supposed to go to the Army. This makes good sense, good management sense.

Mr. FORD. By having the projects in the service that has a substantial interest, I suspect you might get more interest and enthusiasm than you would if you had it in some organization that was purely theoretical and not looking at the practical aspects of it?

Admiral HAYWARD. That is correct. You see, the Navy has been interested in navigation for centuries. The Naval Observatory puts out nautical almanacs for everybody. We furnish all the ephemeral information and we will have to do it in the satellite business.

NEED FOR MILITARY SPACE PROGRAMS

Mr. FORD. For that reason, I fail to appreciate why some people want to take all of these systems and all of these programs and put them over into some civilian agency where there may be a theoretical but not a very practical interest in it. As long as you get the job done, it seems to me that you will get it done better with the people that have a very high degree of interest in the operational capability.

Admiral HAYWARD. Yes, sir; that is correct. This is the reason my testimony was such on this subject yesterday. This is why the proposal now to modify the present act puts the Department of Defense right where it belongs.

Mr. FORD. When we drafted the act in the first place, we tried to put the language in there which protected the military interests.

Admiral HAYWARD. Yes, sir. However, section 102–A started off with emphasis on the peaceful space program and it was stated that the policy of the United States was to pursue space projects for peaceful purposes. In the act you included provisions for developments concerned with weapons and military operation. I think you have clarified this relation.

Mr. FORD. I do not think we have yet.

Admiral HAYWARD. I mean it is before the Congress.

EAGLE/MISSILEER SYSTEM

Mr. MAHON. I would like to ask a few questions here and then I will yield to other members for general interrogation.

I think it is perfectly obvious we cannot spend too much of the resources of the Navy just working out ways to defend carriers. You can devote a certain amount of your energy and money and manpower to defending carriers and the other many ships at sea, but there would come a point where additional expenditures might not be wise, it seems to me. Where that point is I am not able to say at this time.

In connection with that matter, I would like for us to discuss the so-called EAGLE missile and the so-called Missileer.

Admiral HAYWARD. Yes, sir.

Mr. MAHON. We have discussed that some heretofore.

I have a series of questions I would like to read in order to stimulate you to give us a presentation which will answer most of the questions.

It has been stated in previous discussions that the Navy was investigating possible use of an aircraft which is now operational. Was such an investigation made, and what were the results?

Admiral HAYWARD. Yes, Mr. Chairman, the proposals are out for those aircraft now to industry. We have looked at the A–3–J, Vigilante. We have looked at the A–3–D. We are looking at the W–2–F, when we went out with this proposal to industry, and we asked them to look at any present aircraft versus a new aircraft.

Mr. MAHON. What has happened?

Admiral HAYWARD. Those proposals have come in to the Bureau of Weapons and they are being evaluated before we make a decision as to which way we will go.

Mr. MAHON. When do you expect a decision to be made as to which direction you will go?

Admiral HAYWARD. Mr. Franke has told me he wants a decision by ———, Mr. Chairman.

Mr. MAHON. Tell us in some detail just what characteristics you require in the Missileer, such as size, weight, configuration, and so on.

How much difference is there in these requirements and the characteristics of the best of the similar aircraft now operational?

Admiral HAYWARD. The Missileer aircraft, you must review the program. When we looked at the antiair warfare situation we had two ways we could go. We could have gone the F–108 way, mach 3 way, where you put the performance in the aircraft, or the missile way.

What is the secret? How are you going to put performance in the missile? If you are going to build the performance into the missile system and not the airplane, then you walk back the cat—as we say in the Navy—to build a subsonic airplane to try and give you the maximum defense or antiair warfare offense against the opposite system you are comparing it with.

You have another problem in the Navy. Our job is to put the Marines on the beach. We have to have something to cover this interphase between putting the Marines on shore and giving them some air defense while they get set up and while everything gets set in this system.

The EAGLE system and the Missileer have all of the Marine requirements cranked into them. No surface-to-air missile can do this. The EAGLE system can give you a defense against low flying aircraft, can aid and assist the Marines in having aid defense when they need it, before defenses are set up ashore.

The truth of the matter is that, whether it is on land or on sea, the decision of the conflicts still rests with the decision in the air. This means that you cannot afford to let this go. It means that when we looked at this particular system, we wanted to get the maximum for every square foot of carrier deck we had.

The EAGLE system gives us a maximum capability per square foot of carrier space to defend ourselves, and do an offensive antiair-warfare job.

The Missileer aircraft, which, as I said, is under competition now and out to industry, would be a subsonic airplane with what we call a cycle time of 4 to 6 hours. It means that it can stay on station for this length of time. It will carry ——— missiles and it will have the ability, in its system, not only to track and scan up to targets, but it has a great capability compared to any present system.

When we went into this we looked at the F–108, GAR–9, and the Department of Defense looked at the Air Force concept versus ours.

The Stack committee—John Stack is one of the top men in NACA—came to the conclusion that our concept was sound and valid and we ought to proceed with it. The question that really faces us is, do we go to a new airplane or do we use a present airplane today?

I cannot answer that question and would not be able to answer it until I see what the industry has come in with and when it has said, "You can do thus and so with the A–3–J versus a new airplane."

NEED TO DEVELOP NEW AIRCRAFT FOR EAGLE

Mr. FLOOD. Have you not asked for money for a new airplane?

Admiral HAYWARD. Actually we asked for money for the development of the turbofan. We asked for money in the program to cover either a new airplane or the A–3–J and the Department of Defense withheld development money on the turbofan engine.

Mr. FLOOD. There is money in this budget for a new aircraft, missile aircraft?

Admiral HAYWARD. The A–3–J or A–3–D, either one.

Mr. FLOOD. Do we really have any idea of using either of those beasts for this job?

Admiral HAYWARD. This money is for the Missileer.

Mr. FLOOD. Sure it is.

Admiral HAYWARD. I feel myself—I do not want to prejudge the competition or anything else—that you are going to come up and say the cheapest way is to build one of these subsonic machines.

Mr. FLOOD. Is your yardstick how you can best utilize every foot of deck space? Those beasts are busy.

Admiral HAYWARD. Yes, sir; but I want to make sure you understand we are looking at those, too.

Mr. FLOOD. Not very carefully.

Mr. MAHON. Will this Missileer be heavier? How much heavier would it be?

Admiral HAYWARD. 50,000 pounds, pullup weight, takeoff.

Mr. MAHON. How does that compare with your heaviest plane?

Admiral HAYWARD. The A–3–D will weigh in at about 77,000 pounds. The rest of them will run from 52,000 to 63,000.

COST OF EAGLE/MISSILER SYSTEM

Mr. MAHON. How much will the Missileer cost you, including research and development in significant operational quantities?

Admiral HAYWARD. Mr. Mahon, I have made a study of this over 10 years. To put the Missileer system and the EAGLE system into operational use would run to $3.4 billion.

Mr. MAHON. That is your present estimate?

Admiral HAYWARD. That is my present estimate, because I had to make this estimate. I am sure you understand how it is bracketed. I had to compare what it would cost with costs of building a followon to the F–4–H for instance.

If you do not do the EAGLE, what do you do in the fighter and air defense and antiair warfare picture?

In comparing the F–4–H which is a very fine aircraft, I would have to do something in this field if I did not do it in the EAGLE.

Mr. MAHON. You inserted in the record here for all time this $3.5 billion figure approximately. You do not believe history will bear this out? You are confident this figure is too low, I assume?

Admiral HAYWARD. I am not too confident about this, Mr. Chairman, because I put my own Jones' constant in this which is the difference between the right answer and my answer, I guess. I tried to weight the EAGLE system down as I could, because I wanted to make sure. I think that it will be relatively right.

A member of my staff gives me the total cost of only $2.7 billion.

Mr. FLOOD. And we add one-third?

Admiral HAYWARD. I add one third.

Mr. FLOOD. We have for 20 years done this and I have not seen a system come out of here yet that we were not right, Jones' constant to the contrary notwithstanding.

NEW ENGINE FOR MISSILEER

Mr. MAHON. You have $19.5 million in the budget for development of a new engine for this aircraft; is that correct?

Admiral HAYWARD. I do.

Mr. MAHON. What type of engine will it be?

Admiral HAYWARD. A turbofan, Mr. Chairman.

Mr. MAHON. You cannot use any of the presently developed engines?

Admiral HAYWARD. The difficulty is we have not done enough work on the turbofan business in the services and in order to get the maximum out of this system, we want a long cycle time which means a low specific fuel consumption which requires what we call a fan engine.

As you probably noticed, American Airlines bought all brandnew 707's and did not hesitate to go right away and make a fan engine out of the J–57. The J–57 is much too big and expensive for this type of machine.

COST OF PROGRAM

Mr. MAHON. I am going to ask you a couple of questions you have answered already to some degree, but I wish that you would answer them anyway.

How much money has been obligated for the missile, the aircraft, and the engine, prior to fiscal year 1961?

How much is proposed for fiscal year 1961?

What is your best estimate of the total cost of this program?

We have discussed some of the aspects of those questions but give us that information at this point in the record.

Admiral HAYWARD. Yes, sir.

(A classified statement was submitted.)

APPROXIMATE UNIT COST OF OPERATIONAL AIRCRAFT

Mr. MAHON. What will be the approximate unit cost of the operational aircraft, including equipment and the missiles, for the first 100?

Admiral HAYWARD. I can give you some rough figures now. I do not know what the proposals will be, but let me say the EAGLE missile total cost up to fiscal year 1965, including fiscal year 1965, will be $202.3 million.

(Discussion off the record.)

Mr. MAHON. Break down for the record the unit costs of operational aircraft, including missiles, for the first 50 or 100, something of that kind.

Admiral HAYWARD. All right, sir.

(A classified statement was submitted.)

OPERATION OF EAGLE MISSILEER

Mr. MAHON. Will the Missileer be able to operate from carriers smaller than the present *Forrestal* class?

Admiral HAYWARD. Yes, sir. They could operate from those carriers.

It would operate from the modified *Essex*. It is a subsonic ——— aircraft.

Mr. MAHON. Approximately how many would you place on each carrier?

Admiral HAYWARD. This will vary with the mission, as you know.

Mr. MAHON. From where to where?

Admiral HAYWARD. I would say, roughly, you would not have less than ——— and probably not more than ———.

Mr. MAHON. Would you have sort of a constant airborne alert with these aircraft and missiles?

Admiral HAYWARD. Yes, sir. You see, in the anti-air-warfare business, the first thing the missiles did was to put the straight interceptor out of business. No longer can your aircraft sit on the deck and wait depending on the carrier radar to detect the enemy raid prior to launch.

Your surface-to-air missiles, such as TYPHON, will cover the inner zone. The EAGLE Missileer system is out past that and this would be in the air and in an alert status with the rest of the antiair systems that we have.

Mr. MAHON. You mean the Missileer planes would fly constant air alert?

Admiral HAYWARD. Yes, sir; 4- to 6-hour cycle time. You would use it in this manner.

Mr. MAHON. For one carrier task force, about how many Missileers would you have in the air continuously?

Admiral HAYWARD. Off the record.

Mr. MAHON. Day and night?

Admiral HAYWARD. Yes, sir.

Mr. MAHON. If the Missileer proves to be successful, will you still require short range, high performance, fighter aircraft for the carriers?

Admiral HAYWARD. Not short range ones. We have attempted to do two things; first, we will not buy a fighter aircraft that has less than a 2-hour cycle time which means that it has to get out. It will be more of a fighter-bomber type and I say subsonic still. We are great believers in the low altitude subsonic approach to attack. This is the type of aircraft we would go to. We would not replace the F–4H, for instance, as such, as a fighter interceptor.

Mr. MAHON. We will take a short recess.

(A short recess was taken.)

ESTABLISHMENT OF RESEARCH, DEVELOPMENT, TEST, AND EVALUATION APPROPRIATIONS ACCOUNT

Mr. SHEPPARD. Come to order, please.

Admiral Bennett, I am going to direct my comments and interrogation to you because of the fact that you presented the fiscal aspects for the 1961 budget request.

This morning, my colleague, Mr. Ostertag, approached a subject matter which I am interested in and which I would like to explore.

Ordinarily, I try to confine myself to interrogation but in order to bring this picture into focus I am going to make the following comments:

Years ago when the services did less research, engineering for production was done with procurement appropriations. Sometimes called development, it really was not development because, in most cases, general feasibility had been proven by industry beforehand.

Postwar, as R. & D. appropriations became regularized, this committee as a result of hearings began to wonder how much research and development continued to be done in procurement.

Actually, research I think, should be in a definite area. Examination of past records fails to show that "Research" has been undertaken with procurement funds.

Some 3 years ago, in an effort to make somebody or something look good, our friend, Mr. McNeil, pulled out some "test and evaluation" funds from "Procurement." Thus the record indicated to the uninformed something like a doubling of the R. & D. effort.

I am speaking about the volume dollar aspect reflected as a result.

In fiscal year 1961, the request had more transfers and R. & D. looks rather huge as a result of these transfers.

The present rules, under which the Department of Defense is operating, state that research, development, test and evaluation pilot runs and tooling, all are R. D. T. & E. and the only items for inventory or use in the field will be charged to "Procurement."

To me, this is an improper bookkeeper's dream.

I do not know how you may react to my thinking, but it might be adjudicated by those politically minded as a political gimmick.

As a result of this general function, it is my personal opinion that we are definitely creating a defense hazard in this field of function.

One big difficulty is psychological. I will concede that that is possible. The apparent size of R. D. T. & E., as it grows with more and more test and evaluation, is definitely an invitation to cut that appropriation by anyone who reviews it.

In one service, after the one or two sacred "priority cows" are taken off the top, the remaining regular R. & D. is down $89 million for fiscal year 1961 verus fiscal year 1960.

This is a reduction of over 15 percent according to my mathematics.

This has come about because of the psychological effect of such an apparently large item on those trying to balance the service needs against the fixed budget.

Blowing up the size results in an R. & D. sum so large as to invite cuts on general principles.

There are other disadvantages in practice. Suppose, for example, missile X is tooled up and successfully tested. Procurement for use now is from another appropriation. Under law and regulation, will the tooled-up producer get the business, or is someone else to get it, with a loss to the taxpayer? If someone else, is to get the business, do we again have to test a pilot run to be sure of what we are getting?

In engineering for production, in tooling up, it is inevitable that there would be cost overruns in some cases. That is clearly indicated. In an R. D. T. & E. package, there is little flexibility. In a procurement package, fewer articles can be bought to free the overrun cost.

It is my thinking that the "Research and development" appropriation responsibility should end with the demonstration of feasibility.

Engineering for production, pilot runs, test and service evaluation, should be returned to the procurement appropriation where, in my personal opinion, it belongs.

I think the present status is fictitious and very frankly, gentlemen, I think it presents a budget that is not based on a correct premise or correct in its orgiin.

What comments do you have to make on that?

Admiral BENNETT. Mr. Sheppard, with considerable experience in this area, I would agree with your remarks. I would like to repeat, if I may, each of your major premises, possibly somewhat in a slightly different way.

There is not any doubt about it. One has only to look at the history of the Department of Defense and congressional actions. The larger the sum, the greater the tendency, psychologically, to cut back. If something must be cut, it is the large item that one always looks to and on the simple grounds that, out of a large sum, some money will not be missed.

This psychological factor is very real, very real within the Navy Department and within the Department of Defense as well as within the Bureau of the Budget reviews, and even within Congress, as I think can be shown from the record. I think the next point is well taken. We know that under law and regulation that it is almost impossible for a contractor who produces under one contract to be guaranteed, in any sense, business in a succeeding contract. If we are to

carry this concept to its ultimate conclusion, and it is almost there now, then we will be evaluating missiles and we will then have to go forward with a procurement contract and who is to know? Furthermore, if we get another contractor, then we will have to reevaluate it because we have no way of knowing whether the production line Y is going to turn out the same article as production line Z.

As to the question of cost overruns, I think you stated that very adequately. This is inevitable in some cases although we always try, and our contractors are reasonably good at it, to prevent overruns. Sometimes it is inevitable.

In the even larger procurement appropriations, as I think you stated, if necessary you can drop one or two articles to make up the deficit. I feel, as you do, sir, that ending with the proof of feasibility gives you a better picture of research and development and prevents this test and evaluation tail from wagging the whole dog.

Mr. SHEPPARD. Back in the days when we were pursuing that course, were you then confronted with the multiplicity of problems that prevail under the present budget, as it is being presented here?

Admiral BENNETT. No, sir.

Mr. SHEPPARD. You did not have those cost factors added on top of it. You had a more firm determination of the end project and what was going to result from it than you are getting now; is that right or wrong?

Admiral BENNETT. It is my opinion you are correct.

Mr. SHEPPARD. How do you feel about that, Admiral? You have been here, too.

Admiral HAYWARD. You must have read my speech.

Mr. SHEPPARD. Sorry; no.

Admiral HAYWARD. We argued against this for various reasons. I quoted most of the reasons. There are some things we have done in the Navy where you do not have to go to another contractor and this has come under criticism by Congress where we brought the contractor in in the research and development phase and for all practical purposes, he got the production.

I take the nuclear depth charge where the Bureau of Ordnance brought American Machine & Foundry Co. in at the research and development phase, and they got the production.

This was a way to compress time and gain time, rather than going through the series business. This is frowned on by many people as you know, and we have done the same thing with others. The danger is, as I pointed out to the chairman this morning, you get an entirely different impression of the program than we have originally when 3 years ago we came and presented our side of it.

The definitions they have given us from the Department of Defense really make it a tremendous operation. They say that this includes production tooling, too. This is good from the Comptroller's point of view, I guess, and it does have the effect of blowing up the overall budget.

This looks good to some people, but the truth of the matter is that the research and development effort is down in 1961.

Mr. SHEPPARD. Is it not rather obvious that the more satellite aspects—to wit, those I have enumerated here—are added into the total picture, the more the actual application to R. & D. function as we interpret it, is being lessened because of the additives?

Is that not literally true?

Admiral HAYWARD. Yes, sir. However, there is one thing I would say about the flexibility. I would not hesitate in the test and evaluation part of it if I need some research and development to cut off a couple of the missiles myself and use that in research and development. I must present that side of the argument because we do have more money from this point of view. It has confused the issue of the research and development budget, as such.

Mr. SHEPPARD. I can only interpret from the answers of both of you gentlemen that, as far as you personally are concerned, you are not very happy about this kind of operation.

Is my inference in error as to either one of you?

Admiral HAYWARD. No, sir.

Admiral BENNETT. No, sir.

EFFORTS TO DISCONTINUE R.D.T. & E. ACCOUNTS

Mr. SHEPPARD. What are you doing about it? To whom do you talk about it, and why isn't it cleaned up?

Admiral HAYWARD. I have argued this particular case with the Comptroller and with Dr. York. We have argued successfully to keep ships out of test and evaluation because we are building a research submarine. Under the strict definition of test and evaluation, this could be test and evaluation, too. We have kept out of the research of escort ships and the Comptroller has made the decision that he would not put ships in it because my fight has not been too successful in trying to get a real good definition we could live with.

Mr. SHEPPARD. Where do you hit the roadblock? That is what I want to know.

Admiral HAYWARD. With the Comptroller and also the Appropriations Committee of the House which gets part of the credit because this is what Congress wanted, I understand, Chairman Mahon.

Mr. MAHON. Will the gentleman from California yield?

Mr. SHEPPARD. Yes.

Mr. MAHON. As to what Congress wanted, I am not so sure who originated this idea, whether it was Secretary of Defense or Congress.

Admiral BENNETT. Could I speak to that?

Mr. SHEPPARD. I have the feeling that it may have been proposed from both sources probably, but I do not know who furnished the original impetus.

Admiral BENNETT. As a personal victim of this situation, I would like to speak briefly to that one.

I think the statement that the Congress asked for it, is, in my personal opinion, an excuse and not a reason. I have appeared before this committee for quite a few years and I remember very distinctly you gentlemen always used to say, "That is fine, Admiral, but what are you buying out of 'Procurement' in 'Research and Development'?"

The reason that I say that I have a personal memory of this is that I testified before the Senate Appropriations Committee one day and was attacked by Senator Ellender with a figure I never saw or heard of before. As far as I know, this was the first appearance of this test and evaluation item in the research and development budget. I believe it is factual that it originated in the Department of Defense.

The answer to Mr. Sheppard's question, I myself have discussed the point to no avail, with Mr. McNeil personally. He felt that the situation was improved by this device. I do not agree with him, but I am not competent to move Mr. McNeil or his successor, only discuss with him.

Mr. SHEPPARD. Of course, I feel about this situation rather definitely as compared with some of my colleagues, which is their privilege. I am going to tell you gentlemen very frankly that this budget presentation under its present construction is, in my book, an improper presentation. You can agree or disagree, but that is my personal feeling. I do not like it at all and I do not care who is the mother or father of it.

I might ask you gentlemen this question: Why do I find it necessary to bring this subject matter out? Why has not the Navy brought it out previously?

Admiral HAYWARD. I brought it out with Mr. Mahon this morning when we presented the figures to you, Mr. Sheppard. We went back into 1959 and showed you——

Mr. SHEPPARD. You brought it up this morning? I am speaking about the past tense when this was first made. It was wrong from its inception?

Admiral HAYWARD. Yes, sir.

Mr. SHEPPARD. This is the first time, sitting at this side of the table and with due respect to my friends in the Navy, that this thing has actually been brought out and held up here like the skeleton it is. If it is not a financial gimmick, I don't know what is.

Mr. LAIRD. We discussed this last year.

Mr. SHEPPARD. I know, but we did not go into this in detail and the answers are not as explicit as what we are getting now.

Admiral BENNETT. I brought it up myself last year and we did not have time to go into it.

Admiral HAYWARD. I feel that I have fought pretty strongly against trying to distort the picture. I feel very much, Mr. Chairman, that it has distorted the research and development picture. You are not doing any more research and development. You are kidding yourself and there is no sense kidding yourself on it.

I still agree 100 percent with you; it is a gimmick.

Mr. SHEPPARD. I think we are in accord at least on this, to this degree: We have a problem in front of us and I am very definitely opposed to it. I do not have the privilege of speaking for the other members of this committee—they are capable of speaking for themselves—but I do not like this kind of a bad presentation, and in my book the policy stinks.

That goes for the Bureau of the Budget and down to everybody else, and I do not care what the position may be. That is the way I feel about it.

The next question is: What can be legitimately done about it?

Admiral BENNETT. At this point in time, Mr. Chairman, we are under orders from our seniors to write the budget this way. We, at least, can do nothing about it. I, personally, have gone as far as I can, including Dr. York. What the committee elects to do with any appropriation is not for me to say.

Mr. SHEPPARD. I grant you that.

Admiral HAYWARD. Actually, Mr. Chairman, in looking at the 1962 budget it will be up at the $2 billion mark under these ground rules. The time will come, unfortunately, when the first thing you know we will be building ships in a test and evaluation program and it will be in this budget. It will give us a distorted picture.

Admiral ENSEY. May I offer something?

This is hearsay evidence only.

I was told last year that the generation of this idea came from some congressional question as to "how much is actually in Research and Development." At that time, as I was told, Mr. McNeil said, he "just picked it out of his head": the figure was $6 billion Department of Defense-wide. He explained that he was considering the whole process up to the point where the hardware goes into service. If you consider that research and development, should include the development of the weapons to that point where they are ready for use at consider that research and development should include the develop-sea in the Service—if that were the chopping point, you would add all of these costs together to get the total for "Research, development test, and evaluation."

Mr. SHEPPARD. Is it your thinking, from your experience, and budget work—and you have been here a long time and you and the other gentleman as well—that this procedure, irrespective of its origin and irrespective of how it may have been taken, should be continued and permitted to continue as it presently exists?

Admiral ENSEY. We are just starting to live with it. If it is considered as one whole pot, that will give you a poor picture; but if you look at the research and development part as a separate aspect of the whole R.D.T. & E. budget, and see there the test and evaluation part as Admiral Hayward presented it, it may be comparable. Maybe we can live with it and you can understand what we are doing clearly. I do not know.

Mr. SHEPPARD. How much extra work, or how much detriment to the program is involved and whatnot, using all of the evils you wish to apply, would occur if there were a separation of these two operations?

Admiral ENSEY. You remember, sir, I started my presentation off with four or five charts showing all of the budget shufflings last year. This was only one of the evolutions. It about gets the R.D.T. & E. picture now pretty well purified, which is the word we always use about this process.

Mr. SHEPPARD. When you use the word "purified" that covers a multiplicity of sins. I do not like to be taken out in the archives of the past. I try to live modern, especially in these fields of functioning.

How much trouble would it be right now if you were to take last year's budget and this year's budget as contemplated, and put in the record a separation between those aspects I have referred to and those against procurement?

Admiral HAYWARD. We have it right here. We will put it in the record.

Mr. SHEPPARD. Make it a part of the record.

Admiral HAYWARD. Yes, sir.

(The information follows:)

Analysis of R.D.T. & E.N., new obligational authority[1]

[Dollars in millions]

	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961
Research and development	$872.0	$845.8	$819.4
Test and evaluation	302.3	410.9	349.6
Total, NOA	1,174.3	1,256.7	1,169.0

[1] Fiscal years 1959 and 1960 shown on a comparable basis to fiscal year 1961 including minor comparative transfers.

Mr. SHEPPARD. It is my feeling and in my association with members of the committee on both sides of the aisle, that when we realize something is wrong—correct it. A misconception due to the presentation exists in this instance because of ground rules you cannot help yourselves, but once we get a clarification, we are not going to be so stupid as to sit here and take it, once we understand what the picture is. We are not in the habit of doing that. I want to say that on behalf of every man I work with here.

The reason I did research on this and brought it out is that so far as I am concerned, frankly, I think it is wrong. I do not think it is any good. I think there has to be some correcting done, but whether we do it in the committee here, or have the jurisdiction to change this thing, there might be a question on that.

I very definitely want some clarification on this or I am going to object to the funding and I want that understood by everybody in this room.

IDENTIFICATION OF RESEARCH AND DEVELOPMENT FUNDS UNDER PRESENT SYSTEM

Admiral ENSEY. I am sure, and I believe everybody will agree, that there is no intention to confuse the committee and/or cloud the issue. I am sure of that.

Mr. SHEPPARD. When you say no intention——

Admiral ENSEY. Yes, sir.

Mr. SHEPPARD. Would you rather not say that insofar as you, or those with you are concerned, and let me draw my own conclusions about who laid this egg, and what their intentions may be or were.

Admiral ENSEY. Yes, sir. I can only speak for myself, of course.

Admiral HAYWARD. Mr. Chairman, in my presentation I specifically broke this out so that you can see the difference. In 1961 in the test and evaluation category, you have $350 million, and I pointed out the research and development side of it. I did this for 1959 and 1960 just so the committee would see how it is distorted. I believe it is.

Mr. LIPSCOMB. Mr. Chairman?

Mr. SHEPPARD. Mr. Lipscomb.

Mr. LIPSCOMB. Is this schedule that the chairman asked be put in the record quite a detailed accounting problem?

Admiral HAYWARD. No, sir; it is not, because it has been an evolution in making up this year's budget and last year's budget which we have pushed all along the line. Little by little they have done this

and they have broken it out in the procurement appropriation and then it was transferred. There are still some things broken out in the procurement appropriation.

Mr. LIPSCOMB. Evidently you keep your records separately?

Admiral HAYWARD. We have to, because in this shift I am sure that Admiral Ensey has shown the committee how this thing has evolved and how we have done this.

This is why it is fresh in our minds and we have the records right here.

Mr. LAIRD. Mr. Chairman, I cannot see where the Navy has tried to hide anything by this. As a matter of fact, it is broken out so that we could see this very clearly.

Mr. SHEPPARD. Just a moment. The Chair has not said at any time the Navy is responsible for this situation. I simply brought out from the testimony the condition exists.

The statement I have made here, you gentlemen will agree is correct operationally speaking?

Admiral BENNETT. Yes, sir.

Mr. SHEPPARD. Do you feel the same way?

Admiral HAYWARD. Yes, sir. In my testimony I told you that 30 percent of the total budget is test and evaluation.

Mr. SHEPPARD. Now, I say to my comptroller friend, do you feel the same way?

Admiral ENSEY. I feel that what I said awhile ago is so; we fought it, but we may be able to live with it.

We have not really gotten it going yet. As I said, we fought against it but we lost the fight and I do not know whether this is a closed issue or not.

Mr. SHEPPARD. I am not saying you cannot live with anything that somebody makes you live with, but that does not necessarily make it a correct way to live.

Admiral ENSEY. I agree.

Mr. SHEPPARD. When it comes to appropriations before this committee, we are entitled, or at least I feel that I am, to know exactly where this money is going. We want to know if it is going into a series of expenditures under the guise of research and development and we expect to get certain results of research and development, and I tell you that this will not give it to us. You know it just as well as I do.

Admiral HAYWARD. Well, we will do the best that we can to sort it out so that you can see it, sir.

Mr. SHEPPARD. You know the statement I just made is correct; is that right or is that wrong?

Admiral HAYWARD. Yes, sir.

Mr. SHEPPARD. What you have to live with is one thing but my question was directed as to why.

Admiral HAYWARD. If it is not clear, I agree it makes it hard to see.

Mr. SHEPPARD. If we are going to have research and development, let us have it. Let each item stand up on its own feet and be accountable in the respective expenditure category so we can see what it is all about.

I do not know of anything in our total operation that does not have its inception in research and development, and without that, where are you? What do we find?

We are confronted with all of these proposals and they are very fine. I understand all that, but back behind that is the research and development aspect of it. It can only be so good as an end result, as the research and development make it. If you are going into further development, which you state we will have to go into and advance, the more money you spend for neckties, shoes, and what not—then is the time for somebody to make up his mind where we are going in research and development.

If you gentlemen get careless in the expenditure in research and development fields, we are liable to have a chance to know it and throw a couple of these cats and dogs out the window. It might be desirable to do that.

At least, I want the opportunity by the procedure of presentation here to do that. I have been here long enough so that I think I understand something about a budget.

I do not like any part of this type of funding.

Now I would like to refer to something else.

Admiral, referring to the second last paragraph on page 16 of your statement, I quote:

> The propulsion of ships by nuclear energy is an accomplished fact and improvements continue.

I presume you meant that statement literally?

Admiral HAYWARD. Yes, sir.

Mr. SHEPPARD. We can apply the same definitive concept emanating from that statement to the flattops as well as we can to the submarines or any others?

Admiral HAYWARD. Yes, sir.

OPERATION AND MAINTENANCE OF RESEARCH FACILITIES

Mr. SHEPPARD. I now turn to page 18 of your statement and in the last sentence of the first paragraph, I quote the following:

> Examples of these costs are maintenance of buildings, grounds, roads, utility systems, and security.

Out of that type of expenditure requirement referred to in that statement, am I to assume that that falls under the guise of O. & M. funds?

Admiral BENNETT. Yes, sir.

I will answer that, Mr. Sheppard.

This goes back perhaps 10 years where the maintenance of the in-house laboratory establishment was deemed to be within the purview of the research and development appropriations. This has been handled this way for a long time.

Mr. SHEPPARD. Out of the total sum of O. & M. money as of last year, what proportion of it was assigned to the maintenance category and proportion was assigned to operations?

Admiral BENNETT. I do not believe we have it broken out that way, but I would be delighted to supply it for the record.

Mr. SHEPPARD. If you will, please.

Admiral BENNETT. We have a figure for programwide management and support, but it does not include all the maintenance and operation costs in this appropriation.

(The information follows:)

The fiscal year 1960 research, development, test, and evaluation program includes $116 million for maintaining and operating research and development facilities including $28 million for maintenance and $88 million for operation.

Mr. SHEPPARD. From your experience in expenditure categories under maintenance, is there any place, so far, where you have broken into diminishing returns because of lack of maintenance?

Admiral BENNETT. For the research and development appropriation we would have to limit this to our own laboratories. I do not believe this would be a critical area in the research and development laboratories, no doubt, since money is not in very free supply. There would be some deferred maintenance in some of the installations.

Mr. SHEPPARD. In other words, am I right in this assumption: Because of the combination of those two funds and also because of a tight budget operation, is it rather easy to reach into the maintenance fund as compared to that of the operational fund, comparatively speaking?

Admiral BENNETT. I think one could assume this, Mr. Sheppard, but I am not sure it is a fact because our laboratory directors and their civilian chief scientists are pretty conscientious about keeping the operating program in the true research and development role.

Mr. SHEPPARD. Has there been anybody from your office, Admiral Bennett, take a check on the expenditures in the O. & M. funds wherein it might be indicated that maintenance is slipping very badly and there is a built-up backlog in their mechanical devices and other appurtenances thereto?

Admiral BENNETT. I do not believe that, as far as the laboratories for which I am responsible, this would be a very significant item. The Bureaus would have to answer to their own laboratories, because they handle this as a part of their business.

Admiral HAYWARD. Mr. Chairman, we are hurting in maintenance, certainly. I could name—but I am sure the Deputy Chief of the Bureau of Ships will talk about this. I do want to clarify the record. There are only minor operating costs included in programwide management and support, and the operating costs in most instances are covered by the project costs. You are really talking about maintenance?

Mr. SHEPPARD. That is right.

Admiral HAYWARD. Maybe there is some security involved, perimeter guards.

Mr. SHEPPARD. The principal thing I am interested in here has been the result of an elaborate field check. This does not apply to the Navy exclusively by any stretch of the imagination. This is across the board; Army, Air Force.

There was a tremendous backlog of diminishing returns in evidence across the board on this. It is rather obvious to me that the reason for that is because you are working with uncertain limitations and obviously when it comes to an operational factor versus that of maintenance, even in my concept, I would say operations come first.

As a result of that requirement, this is falling far behind and further behind every year.

Admiral HAYWARD. You are correct, Mr. Chairman.

Admiral BENNETT. It is bound to have that effect.

Mr. SHEPPARD. That is all, Mr. Chairman.
Thank you for your courtesy.
Mr. MAHON. Gentlemen, thank you very much.
We stand adjourned until 10 o'clock tomorrow.

THURSDAY, MARCH 17, 1960.

ANTISUBMARINE WARFARE PROGRAM

Mr. MAHON. We shall resume the hearing.

Mr. Laird and Mr. Lipscomb, in company with staff assistant, took quite a look at the antisubmarine warfare program last fall. I think they did a good job and I think they performed a public service in looking into these matters and I am personally very grateful to them.

I will yield now to Mr. Laird.

Mr. LAIRD. Admiral Hayward, I do not want to get into the position of being a project officer so far as the ASW program is concerned, but I have some questions, and I believe it is proper for us on this side of the table to ask questions about the ASW program.

It seems to me that if we looked to 1965, and beyond, ASW will be the primary job assigned to the Navy.

There are many Navy people who do not think it is the primary job of the Navy at the present time. I would have to agree with them. These Navy people may think they have far more important responsibilities now, perhaps; but as you look to the future I believe they are wrong. Take BMEWS, the early warning systems, and other programs on which we have spent vast amounts of money—we will be able to look back on these systems and say we probably made a great mistake. The various early warning systems that are being set up are not going to be able to defend against submarine-launched missiles.

The entire NIKE-ZEUS program is out the window so far as submarine-launched missiles are concerned. We hear a lot of talk about how we have to go forward with the NIKE-ZEUS program and some of these other programs, but it seems to me when we start considering the 1965 budget we will be talking about other matters. It will all come right back to the threat that America faces from the submarine.

You have submitted a list here of certain research and development projects which you place at a very high priority in your budget. These are additional ASW items for which you were given additional money. Is that right?

Admiral HAYWARD. That is right.

Mr. LAIRD. Do you agree that the BMEWS and some of the air defense programs like NIKE-ZEUS on which we are spending a great deal of money, will not have much effect on submarine-launched missiles?

Admiral HAYWARD. This is correct, Mr. Laird.

I feel when BMEWS is finally finished, as I said yesterday, the premium on surprise will have faded away. You will have systems that will not be vulnerable to surprise.

If you look at ASW just in the context of continental defense, this is one way to look at it.

Of course, as Admiral Wright has stated, 95 percent of his people and his forces are involved in the ASW picture.

But you are essentially correct in the statement that the BMEWS and the NIKE-ZEUS would be of little use against a sea-launched ballistic missile.

Mr. LAIRD. You bring up the percentage Admiral Wright used. I talked with Admiral Wright, and certainly he did devote a great amount of effort in this particular area, and the number of ships assigned to this particular work associated with ASW is very high.

NEED FOR INEXPENSIVE ASW SHIPS

How much money would it cost to be able to keep the same number of ships at sea that you can keep at sea now on ASW in the next 10-year period over and above the amount of money permitted in the ship budget at the present time?

Admiral HAYWARD. I could not answer that right off, Mr. Laird. That is a good question, though.

Admiral Wright, and you spoke to him, told you how desirable it would be to have more of these groups at sea. Numbers of forces are important in the ASW business, as you know, and you have to have mobile forces.

Mr. LAIRD. It seems to me in this entire ASW picture, if you are going to keep these forces at sea, the research and development primary effort should be to utilize the present techniques we have on as many listening platforms as we can. I do not see how you can do it with these expensive ships.

Admiral HAYWARD. You have a very good point. We are going ahead, as you know, with the PCH, the Hydrofoil. We are looking around in the Hydrofoil business. If we can get an inexpensive platform, or do it by buoys that are monitored, or in any way try to make more effective the units you have now, we should do it. I agree with that.

Mr. LAIRD. In talking with some of the people who are actually operating in the fleet, it seems to me that one of the major functions of your shop should be to try to work in this particular area. I do not think we will find any major breakthrough in new techniques to detect the submarine.

However, if we are going to have the kind of equipment we presently have, we have to have a lot of listening platforms.

Admiral HAYWARD. That is correct.

Mr. LAIRD. How much are you funding on research and design so far as ASW ship design is concerned?

Admiral HAYWARD. For the PCH, for example, which is the 110-tonner with the variable depth sonar, we hope to get, as I understand the figures, about $5.2 million. If you can get platforms of this kind which can go at ——— knots on the foils, at that price you can get numbers which you cannot get of the more expensive ones.

DESTROYER LIMITED IN ANTISUBMARINE WARFARE

Mr. LAIRD. It seems to me that the destroyer has reached a point here where it is not as adequate as a defense weapon against the submarine as it was in World War II because of the speed of the submarine. You will not be able to use the destroyer too much if you have submarines going at a much more rapid pace than the destroyer.

Admiral HAYWARD. However, you must remember something about the submarine. In our recent exercise with the DesFlot 2 and others, with which you are familiar, with the *Skate* going at 20 knots, she could not get away from the *Abbott*.

When a submarine goes fast she cannot do much, either. In this particular exercise the *Skate* went right through the whole convoy and didn't even know it, trying to shake the *Abbott*.

In this particular case the *Abbott* unfortunately didn't have enough standoff weapons. She got the *Skate* and did very well with it.

Mr. LAIRD. The *Skate* is not a very silent submarine to be chasing around, though.

Admiral HAYWARD. No, sir; but whenever a submarine goes fast, she makes noise.

Mr. LAIRD. I speak of 1965 and in this area of ship design it seems to me you have to look at least up to that period.

Admiral HAYWARD. That is right, and that is why we look at ——— knots, for instance, in the hydrofoil craft. We would like more speed. We would like 80 knots. We have a lot of work to do on the supercavitating type in the foils, but we would have to make more effective the units we have. We should get as much for the dollar as we can in each unit.

Looking at it from the submarine point of view, because we have the same problem in our submarines, at high speeds they have a lot of problems also. We should have a speed advantage of at least one and a half over them, I should say, to make the vehicle effective.

Mr. FORD. You mean 50 percent more?

Admiral HAYWARD. Yes, sir. And that is giving the submarine the ability to be able to do something at those high speeds.

ASW has changed from World War II. ASW is divided into three fields. You have ASW where the submarine comes to destroy targets, the missile business.

You have ASW to protect convoys.

You have ASW when you want to do something off somebody else's coast in a limited situation, so you have three facets of the operational problems that face you.

Where the submarine comes to destroy your cities she comes to evade you. You only wish she came to sink you. In this case she will be quiet and slow and she will not be chasing around at high speed. That is the last thing she will do.

When she comes otherwise against the convoys she would use this speed. She would use every bit of performance she has.

SHIP IMPROVEMENT

Mr. LAIRD. How much did you say you had in here on hulls?

Admiral HAYWARD. We have the PCH in the SCN 1960 funds, and in hydrodynamics we have——

Admiral BENNETT. If I may interject, if you want an overall figure we would have to add it up differently. When you start talking about the improvement of ships you are really not only talking about hydrodynamics but also about ship structures and several other things.

I offer this only if you are looking for an overall figure which would be labeled "The Improvement of Ships."

Mr. LAIRD. I looked over last year's budget and it seems to me you had about one-fiftieth of 1 percent of the entire shipbuilding budget which went into advance ship design. It did not seem to me that with the problems we face in ASW that this effort was sufficient. It seems to me you were going ahead in the same manner in this 1961 budget. You have $35 million for the project called Atlantis. You do not even know whether you can spend that money until perhaps next October. I refer to a year from October and not this October.

Admiral BENNETT. That is right.

Mr. LAIRD. I think we have to move forward with what we have.

Admiral BENNETT. I do not believe you can relate this to the shipbuilding budget, sir. It is not a very expensive area to perform research in. You have water tunnel tests, tests of structures, supercavitating propeller and supercavitating hydrofoil. Even when you add all these things together it is not a large percentage of the shipbuilding budget.

Admiral HAYWARD. $6.3 million, roughly. That is in the R.D.T. & E. portion of the program.

Admiral BENNETT. I would agree on that approximate figure.

Mr. LAIRD. You do not have anything more requested in that particular area. You did not request any more, did you? At least in the list I have before me you received everything that you requested. That is why I ask the question about it. I looked at the add-on list and I saw nothing in this area. I thought perhaps you were satisfied with this funding.

It would seem to me as a layman, not being a military expert, that this is an area where if we were to meet this threat from 1965 to 1970 it would be even more urgent than some of the projects such as Atlantis.

Admiral HAYWARD. Under "Vehicles, propulsion, and equipment," where we had $35 million in 1959, $37 million in 1960, it is down to $29 million in 1961. On page 12 you will find fundamental hydrodynamic research.

Mr. LAIRD. Let me get the same sheet you are using.

Admiral HAYWARD. Look at page 11 of that sheet, Mr. Laird. You have the sums for hydrofoil, hydromechanics, ship maneuverability and stability, exploratory ship design.

Mr. LAIRD. I have it now.

Admiral HAYWARD. On page 12 you will find we have $2.3 million, and our requirement is $3.3 million in that area. If we were given the add-on it would go into the ship's hull and propulsion.

Mr. LAIRD. The hydrodynamics item on page 12, and the item I speak of on page 11 cannot be attributed to ASW.

Admiral HAYWARD. Anything that will permit you to do your ASW job better——

Mr. LAIRD. I think all of this on page 11 can be ASW, but is this on page 12 related to it?

Admiral HAYWARD. That covers everything, any hull design to do your job more efficiently.

Of course, you can cover the research submarine, the deep diving submarine, as a new vehicle. That is not in R.D.T. & E. but in SCN. It is also in the same category, however.

Admiral BENNETT. This item referred to on page 12 in the past was the genesis of the hydrofoil applications of the present. The structure

mechanics, mentioned somewhere, was the genesis of such things as improved construction of the ships for lighter weight. These all contribute to the ASW program although not exclusively to it.

ASW HYDRODYNAMIC RESEARCH

Mr. LAIRD. In this area, then, if you included all the items under hydrodynamics research and all those under hull hydromechanics research, your add-on would be how much?

Admiral HAYWARD. $600,000 on page 11, $1 million on the first item on page 12, and the second item on page 12 is roughly $1.5 million. ONR has hydrodynamics research at $1.3 million and we would go to $2.8 million on that.

I will furnish the breakdown for the record on that in detail.

(The information referred to follows:)

ASW hydrodynamic research

Project No.	Title	R.D.T. & E. basic fiscal year 1961 budget (thousands)	Additional requirements (thousands)
SF-13-02	Hull hydrodynamics includes hydrofoil craft, submarine and destroyer hydrodynamics and exploratory ship design	$826	$630
SR-009-01	Fundamental hydrodynamic research	2,320	1,000
WR-009-01	Basic hydrodynamics (boundary layer control and flow noise)	1,787	600
RR-009-01	Basic studies in all aspects of hydrodynamics including supercavitating flows, jets and turbulence, forced mixing in boundary layers, propeller theory, ship-motion theory, wake effects, ships of minimum wave resistance, untilated propellers, oscillating hydrofoils, and fluid motion and sound	1,375	1,500
	Total, R.D.T. & E.	6,308	3,730

NOTE.—Significant Navy efforts directly supporting hydrodynamic research but funded by other appropriations include the hydrofoil craft (PGH), the *Albacore* conversions, the escort research ship, and the deep-diving submarine.

Mr. LAIRD. I am not trying to argue here. I realize you have problems with the budget, but it seems to me that that is not very much for ship design when you have such great problems in this area.

FUNDS FOR SHIP DESIGN

How much will you spend in ship construction this year? I want to know how much you are spending on ship construction and then I want the amount you are spending on basic research in this area. Your ship design is based on this basic research which you are doing right here out of this account.

Admiral HAYWARD. This is only ASW we are talking about here.

Mr. LAIRD. That is all I refer to. You have ship construction broken out somewhere.

Admiral HAYWARD. We have it right here.

Admiral BEARDSLEY. About $2.0 billion.

Admiral HAYWARD. Would you like to have for the record what is spent on research in ship design, not just pertaining to ASW but overall?

Mr. LAIRD. I am interested in ASW. I think that this is the problem your ships will have in the future. I do not think that problem is being very well solved today. That is my opinion.

Admiral HAYWARD. Your statement about $6.3 million you think is a small effort for ship design compared to the total?

Mr. LAIRD. All effort for ASW ship design and for basic research. When you consider the other amounts of money you are spending in the ASW effort this is so.

Admiral HAYWARD. Our ship-design money is pure hydrodynamics and it is not included in this appropriation at all.

Admiral MOORE. It comes out of a different pocket. It comes out of SCN and S. & E. funds. The amount of money that goes into the design of ships per se, the weapons we put on, how they are integrated, and what have you, if that could be tabulated it would be astronomical. This figure is only associated with pure research in the hydrodynamic features.

Mr. LAIRD. From this account you will determine whether you can build something fairly cheap. If you just keep up with what you have now so far as listening platforms at sea are concerned, this is the area where you have to spend the money in order to find those particular types of vehicles.

Admiral HAYWARD. Mr. Laird, you are right. Dr. York agrees with you too. He has told us he would give us more money for this area right away. You are essentially correct from a basic research point of view because that is a small sum of money to put on this.

Mr. LAIRD. Has he indicated he would go along with funding on that?

Admiral HAYWARD. Yes, sir. He has indicated he would give us money particularly for hydrofoil craft up to 350 tons. He has asked me whether I would back the Canadian 200-ton hydrofoil craft.

He has indicated that he would give us a sizable sum of money for this.

Mr. LAIRD. You do not think there is any problem within the defense problem in funding this particular area properly?

Admiral HAYWARD. No, sir, I do not, Mr. Laird.

INDUSTRY EFFORTS IN ASW

Mr. LAIRD. I have a couple of questions with regard to industry's position. Have you read Missiles and Rockets magazine for August 10, 1959, in which they state in their editorial: "Navy fails to solve ASW problem."?

The last four or five paragraphs of that editorial, which I would like to insert in the record if I may——

Mr. MAHON. Without objection we will insert it in the record.

(The article referred to follows:)

[From Missiles and Rockets, Aug. 10, 1959]

NAVY FAILS TO SOLVE ASW PROBLEM

It is basic military doctrine that close behind any new offense will appear a defense. The time and the effectiveness vary but historically the doctrine has proven itself, the world has watched this spectacle of defense and offense leapfrogging each other over the war-marked centuries.

It is in the periods when the development of the defense lags unduly that nations find themselves in the greatest danger, whether the weapon be the phalanx, the catapult, the long bow, or the satellite missile-firing platform.

The United States today finds itself facing such a problem in not one but two fields. The first is the anti-ballistic-missile missile. The second is in anti-

submarine warfare. Of the two the second seems to us to be much the more dangerous for two reasons.

First: Despite a great deal of talk about the "missile gap," the probability is that both the United States and the Soviet Union will actually perfect long-range ballistic missiles in roughly the same time period. Any advantage the Russians may have for a short time will be offset by the Western Allies long-range bomber force. These factors seem likely to prolong the same sort of standoff under which the world has been living, perhaps indefinitely.

Second: No such equality of force exists between the Soviet and U.S. submarine fleets. It is true that we have the first atomic submarines and are building more, and that their feats have been spectacular. But indications are the Russians will not be far behind with their own atom-powered subs. Certainly their accomplishments in the reactor field in other endeavors can leave little doubt that they have such a capability.

The more important fact is that the Russians have a huge fleet of some 500 submarines as opposed to 113 in operation by the United States (5 nuclear).

Times and tactics have changed a great deal since World War II. Then the submarine was intended and directed to operate exclusively against other ocean craft. Today the submarine has the capability of operating not only against shipping but against the cities and military installations of the enemy as well.

In the first instance, in the words of Rear Adm. John S. Thach, commander of the Navy's Task Force Group ALFA;

"Hitler started his war with about 60 U-boats, the old-fashioned kind that could submerge only temporarily, and he nearly strangled us. The Russians have eight times that many right now. Most of them are new. They're fast. Snorkels are standard equipment. Nuclear propulsion is only a matter of time." Admiral Thach is one of the Navy's sailors responsible for building a submarine defense. He will admit that in war games his own opposing snorkel subs confound his defenses all too frequently.

Even if we ignore the possibility that the Red subs might throttle the sealanes, concentrating on the theory that the next war will be short, if unhappy, and that supplies can be handled via the air, this does nothing to dispose of the missile-throwing sub which could operate in the Atlantic, the Pacific, and the gulf.

Since we have not and probably will not have for some time a defense against a ballistic missile—certainly not against one fired from short range—then the problem here is exactly the same as the problem of protecting shipping. The only defense is to get the submarine itself. And a conventional sub can toss a missile just about as well as a nuclear sub.

Industry, which has been working fitfully on this problem for some years, details two main obstacles they have run into—and many responsible Navy officers agree. These are:

Lack of money: The price of one carrier, for instance, would go far toward the solution.

Concentration of effort: Instead of scattering the responsibiilty between the Bureaus of Ordnance, Ships, Aeronautics, and the Office of Naval Research.

A poll of more than a score of companies who have worked on the ASW problem, including putting their own funds into it, has revealed almost a unanimity of response on the latter fact. Almost invariably it went like this:

"One of our greatest problems in dealing with the Navy on ASW is that there is no single group within the Navy Department responsible for the entire antisubmarine field and, therefore, it is difficult for a contractor to anticipate or, indeed, discover the total needs of the service in this area."

And another, from a company which had spent $100,000 of its own funds:

"The most difficult problem encountered to date in conjunction with ASW is the lack of consistency among many Navy agencies as to what the requirements of the Navy really are in the ASW area."

It seems to us that the conclusion is inevitable. There are many precedents in the services for establishing a special group—task force, division, command, call it what you will—to concentrate the best skills of the Navy and industry toward solving one of the most dangerous threats which the country faces. It should be done quickly. And it should be given a priority on money and manpower to be successful.

CLARKE NEWLON.

53211—60—pt. 6——25

Admiral HAYWARD. I have read the story, Mr. Laird.

Admiral BENNETT. Would you like statistics on that, sir?

Mr. LAIRD. I would. We received this same complaint when we met with the industrial group.

Admiral BENNETT. Mr. Laird, you have to recognize it is a great American right to be a little upset if somebody doesn't buy your own particular product. We come across this all the time.

As a matter of my own interest in this sort of article, and there have been several, we have some statistics worked up.

The number of proposals with cost information, unsolicited, in the ASW area from industry, over the period January 1, 1958, to December 31, 1959, totaled 386. There were 100 proposals without any cost information. In other words, this was just an idea.

There were 48 proposals at no cost to the Government. Of that total number as an aside 24 have been accepted, 7 are pending, and 17 have been rejected. The total number of proposals accepted and funded over this period totaled 155. The approximate funding was $26 million. I can elaborate on those statistics.

Mr. LAIRD. Statistics speak for themselves. That looks like a good record.

Admiral BENNETT. We believe it is, sir. We believe this is only human nature. It is a criticism to be expected, and we do our best to carefully survey all proposals and inventions and to accept all of those which appear to have newness and merit and are worth while within the available funds.

Admiral HAYWARD. And, Mr. Laird, for a place to come to, my office has been designated by the Chief of Naval Operations for any proposals. If they want to come in, Admiral Yeager and I work closely together on it. Proposals are sent to the cognizant bureaus. As the records show, I think we have done quite well with it.

I talked to the man who wrote that article and he did not know of these figures at all.

Admiral BENNETT. One other thing I might mention, Mr. Laird, since I have been in this ASW business a long time. You also have a problem with the man who invents something, whether it is a proposal or actual piece of equipment. He very frequently does not know that this is actually being done elsewhere, has been done, or is in some way not a bit novel. It is only natural for him to resent the fact that his pet idea is not immediately accepted. In many instances, in all sincerity, people will make proposals that are duplications.

Mr. LAIRD. Do you not give them any word as to the status?

Admiral BENNETT. We try to do that but some people you cannot convince. We have one industrialist who has spent over $1 million of his own money on something which was outmoded years ago but he is so convinced that it is new and original we cannot stop him. We do our best, sir.

NAVY ORGANIZATION FOR ASW RESEARCH

Mr. LAIRD. You are familiar with the reports of the East Coast Committee on Antisubmarine Warfare of June 1959, and the West Coast Laboratory for Antisubmarine Warfare Research and Development Committee, dated February 2, 1959?

Admiral HAYWARD. Yes, sir.

Mr. LAIRD. The east coast laboratory report is very critical of the type of organization there is within the Navy for ASW research. I can quote from the report, but I think you are familiar with it.

I quote from this report:

> The major problem with respect to R. & D. in ASW is the lack of adequate direction and coordination. The present R. & D. program in this field, although extensive, is widely confused organizationally and is made up of many fragments of programs under no central responsible agency.

Has that been corrected to your satisfaction?

Admiral HAYWARD. I believe so. To review a little history on this, those reports stem from Admiral Bennett and myself and Admiral Weakley going out and giving the senior scientists the problem as to how one would better operate the laboratories from a ASW program point of view, and did it make sense to go into one centralized ASW laboratory.

As you read both reports you will see that setting up a single ASW laboratory did not make sense. The ideas of Dr. McLean, Dr. Kurie, and Dr. Henderson, who were in on the west coast report, were that they as a group would run a program. However, I believe that when I got McLean, Hartman, and a group together with the Bureau Chiefs, the setup they have now is considered satisfactory. Dr. Hartman is the chairman at the moment.

Admiral BENNETT. That is a new group—Undersea Warfare R. & D. Planning Council chaired by Dr. Hartman of NOL.

Admiral HAYWARD. That is right. This is an outgrowth of these reports. Dr. Hartman came before us not so long ago with his proposed program as to what they would do in ASW research, which was a very sound and solid program. It has the advantage of putting the people who have the responsibility to do the job, and the authority to do it, in a position where they can go over the program.

When that first report was written it was probably valid that all of the laboratories did not review the entire program as they have in the 1961 budget, for instance.

COORDINATION BETWEEN LABORATORIES

Mr. LAIRD. When we were out at San Diego at NEL we discussed certain projects for which they requested research funding. They could not understand why the Navy had turned certain projects down. They had had no word on why they had been turned down here in Washington.

We found out that the Navy had approved the projects and were doing them on the east coast in New London.

It seems to me there should be better coordination between those programs. They were downhearted about their projects being turned down. As a projects officer it is bad for his morale. You can explain it, but he did not have the information that we had; that is, that the project was going ahead at New London.

It seems to me that is something the Navy should work out.

Admiral HAYWARD. I cannot understand that, Mr. Laird. I read about what you found out there. The funny thing is that Dr. Kurie was leaving. As a matter of fact, he had a short visit with you before going down to a meeting of the Council in the Tongue of the Ocean area. I did not understand this and I agree with what you say. I do

not know why he did not get that information. He is a member of that group, and they meet quite regularly and they have gone over the entire 1961 program in ASW.

Mr. LAIRD. It would seem to me, though, that that is very important.

Admiral HAYWARD. It is vital. It is basic communication. If you do not get back and forth you can have trouble.

Admiral MOORE. The Navy Electronics Laboratory in San Diego and the Laboratory at New London come under the Bureau of Ships and they are administered by Captain Fahy, our assistant for research.

In addition to the coordination Admiral Hayward has spoken to, we are constantly getting laboratory heads together from all of our laboratories with a view of running through our programs and making sure each laboratory knows what the other is doing. There is an interplay between the laboratories and we are getting all the information that is know.

These are going on quite frequently. The last one Captain Fahy held no longer than 2 months ago. These are held at regular intervals, so these programs are gone over.

It is not unlikely that you can go to a laboratory at a given period of time and for a short period the Director himself would not be knowledgeable as to the reason that he did not get information or who was working on it.

I think it is only natural, just as you ask questions here now, that they cannot be answered in a hurry and many times we will say "We will research that and put it in the record."

There is no question that through the years perhaps coordination between the laboratories might not have been as good as one would have desired, but there is some advantage in having the laboratories working somewhat on their own.

However, we are making every endeavor now to get together heads of all laboratories within the Bureau of Ships, constantly get the heads in, and go over the programs with a view of trying to get maximum return for our dollar.

Mr. LAIRD. What do you think about doing that with all laboratories across the board in the Navy?

Admiral HAYWARD. We are doing that. Admiral Moore was talking for the Bureau of Ships. This Council I mentioned consists of the Bureau of Weapons Laboratories as well as the Bureau of Ships and our laboratories.

In 1961, this ASW budget before you now was the first one they had a chance to look at.

In the formulation of the 1962 budget for ASW that program will go to the Council for review so that all the laboratory directors of the Navy, Bureau of Ships, Bureau of Weapons, and ONR, will see our proposed program for the 1962 budget.

As you see, this has taken time to put into effect.

It was a good suggestion, and what got us to really doing it was Dr. Killian's recommendaion to Admiral Burke that we look at whether we should not go to a single ASW laboratory. This is why we want to use the present installations we have and not build another one.

Admiral BENNETT. I might add one thing, Mr. Laird: Just last week senior scientists of all the Navy laboratories met on the west

coast for 2 days to go over their joint problems and problems of interest to the whole Navy.

Admiral HAYWARD. Mr. Laird and Mr. Lipscomb have done us a fine service and have helped us tremendously with this problem, Mr. Chairman. Any time you are interested in any particular area I think it is very beneficial not only to the service but to your committee.

Mr. FORD. I would like to hear it, Mr. Chairman.

I would be glad to give all or most of my time to Mr. Laird.

(Discussion held off the record.)

SECURITY PROBLEMS IN ASW

Mr. LAIRD. One thing that bothered me, Admiral Hayward, so far as the ASW program is concerned, was the kind of work you are doing so far as security is concerned. It does not seem to me that that system is very secure in San Franciso. It seems something has to be done with that.

They say this is the way the system is and they have no plan. Is there not some suggestion that can be made through your shop to improve security?

(Discussion off the record.)

Admiral HAYWARD. That is a physical security problem. We will have to take some action on your recommendation.

There is another side of security, as you know.

(Discussion off the record.)

Mr. LAIRD. That would be much more difficult, though.

Admiral HAYWARD. It would be much more difficult. There is no reason why we should not improve our physical security of the station itself. I refer particularly to that instance that you cite.

That system really is just getting on now. I do not know whether you referred to the east coast, but——

Mr. LAIRD. I went to the east coast, too. I visited the east coast. I went to Norfolk, also.

Admiral HAYWARD. As a general statement you would say physical security should be improved?

Mr. LAIRD. I think you have a tougher problem on the east coast than you have on the west coast. The problem is a grave one.

Admiral HAYWARD. I says we can do better.

Mr. LAIRD. Perhaps nothing can be done.

Admiral HAYWARD. I think we can improve it, Mr. Laird, and we should.

OCEANOGRAPHIC RESEARCH

Mr. LAIRD. What are you funding so far as basic research on oceanographic chart 8 is concerned?

Admiral HAYWARD. The survey side of the picture?

Mr. LAIRD. Yes. I think that is account of SF–304.

Admiral HAYWARD. We have the ASW environmental prediction system on the sonar. We have the POLARIS survey program. Do you refer to the sonar prediction system?

Mr. LAIRD. That is right.

Admiral HAYWARD. $880,000 in this budget for it. We actually need $1 million more to do it in the time I thought we should do it.

This is a very valuable help to the ASW operations.

Mr. LAIRD. What kind of priority does that have?

Admiral HAYWARD. After getting more information from the operational forces we have placed this much higher in priority than it was when this budget was prepared.

Mr. LAIRD. People you talk to who are operating in this area with the fleet seem to place it in a much higher position than you have placed it.

Admiral HAYWARD. Yes, sir, they did, Mr. Laird.

This budget was made up in October or November of last year. When Jimmy Thach left he came in and talked with us and I reprogramed this and put it much higher. I would like to do this in the time the operational forces need it. That was the first time they had come in and told us this.

Mr. LAIRD. I talked with Admiral Thach before he went out to the Pacific and he impressed upon me the idea that this problem was one where they ran into many difficulties in their operations.

Admiral HAYWARD. We are doing the high-priority areas first. The Atlantic was ahead of the Pacific.

In this year's budget in other appropriations you have about $14 million for surveys actually. This is the hydrographic and oceanographic work done by the Hydrographic Office. That is a different appropriation from R. & D. However, "ASWEPS" is in R. & D. and is a prediction system which the Hydrographic Office is doing for us. We should up the priority on it and we will do so.

Actually this came in from the Atlantic more than it did the Pacific, Mr. Laird. The Pacific is an easier problem off the west coast from results we have to date than the Atlantic has been. The prediction system has worked quite well.

Mr. LAIRD. In this whole area I was convinced that your weapons were running far ahead of your detection system.

Admiral HAYWARD. You are correct. However, we have had some good results with our new detection systems.

U.S.S. "BARRY" ROLE IN ASW

Mr. LAIRD. You had some problems with the *Barry*, did you not?

Admiral HAYWARD. Yes. We had cavitation because we did not have it deep enough and we were putting out a lot of power. I think we have it licked now.

Here is an exercise which shows results as of January 1960. We had a sortie. This was an amphibious exercise where they launched out and were opposed by three submarines. The convoy was protected by destroyer escorts and destroyers, and the *Barry* was in the screen.

The subs failed to penetrate the screen at any time due primarily to the actions of the *Barry* equipped with the SQS–23 sonar. The shallow water at that particular part of the Atlantic precluded use of the variable depth sonar in the *Willis*.

However, isothermal conditions permitted all detection within the layer. We employed the *Barry* as an outer sonar picket to give early warning of sub locations. *Barry* made contact at ——— yards verified as positive submarine. Weapons currently on board are short-range torpedoes. Ships simulated from ——— yards mark 37 torpedo at-

tacks. Final phase in attempting tornado Mark 32 attacks brought on counter torpedo attacks from submarine at range of approximately 1,000 yards.

Other contacts were verified by magnetic detection gear. These submarines followed similar patterns with initial detection ranges of ——— yards. This was accomplished against nonnuclear subs with technical defect in source level of the SQS–23 at ——— decibels down ——— decibels from specs.

The major lesson on this was weapon range and not sonar detection capability continued to be a most urgent necessity for ASW effectiveness.

You can see the position we are in. You make an advance in one, and all of a sudden you find you can get the guy at ——— yards, and you have no weapon to get him.

Mr. LAIRD. What about the Mark 46 program?

Admiral HAYWARD. The Mark 46 comes into operational use in ———.

Mr. LAIRD. You are pretty well set that the program is all right?

Admiral HAYWARD. It is a fine program, and it is going ahead.

If we had the Dash system on the *Barry*, he could have used that for the ——— yard range very easily with the Mark 44 torpedo. It is one of those games where you get ahead in one, and you are behind in the other.

You have to have weapons to match the SQS–23, and this is what the Dash system will give us.

Mr. LAIRD. The 46 gives you that, does it not?

Admiral HAYWARD. The Mark 46 would not give you ——— yards range from the destroyer.

Mr. LAIRD. You have to have the torpedo to go with the Dash program, or would you put the 44 on it?

Admiral HAYWARD. The Mark 44 would work very well on this. ASROC is ——— yards, you see.

When you went there the statement was valid. Once we get the new detection equipment in the fleets you can see we are back where we have to get on weapons again.

I think it is in order and we will come in in time with the best overall system.

Mr. LAIRD. That is all.

Mr. MAHON. Off the record.

(Discussion held off the record.)

ASW EFFORTS BY INDUSTRY

Mr. SIKES. How many company proposals did you state you have had, Admiral Bennett, in the development of ASW techniques?

Admiral BENNETT. Total number of proposals for all kinds of ASW——

Mr. SIKES. That is what I refer to.

Admiral BENNETT. Over the period January 1, 1958 to December 31, 1959 there were 534.

Mr. SIKES. Just about one for each existing Russian submarine. How many have you accepted?

Admiral BENNETT. We took on 155 of those, Mr. Sikes, some 214 are still pending, and most of them are of recent receptions.

NEW ASW TECHNIQUES

Mr. SIKES. Let us get into the field of current promising ASW devices or techniques.

Mr. Laird has performed a very fine service by exploring this matter as fully as he has.

Would you sum it up for me in one-two-three manner and tell me what new techniques which have come into focus since the last hearing a year ago offer greatest promise to date?

Admiral HAYWARD. Let us start with classification, detection, and localization. In the classification situation we have quite a few developments on magnetometers coming ahead. Particularly you have the proton magnetometer, a ——— magnetometer which looks like it will make the magnetometer the most advantageous device we have for classification.

Mr. SIKES. What is the stage of development?

Admiral HAYWARD. Actually we have one of the Varian types which has been out for evaluation with Task Force Alfa. This is further ahead than the ——— magnetometer which is strictly in the research stage now.

In detection and localization the Jezebel system is coming along very well. That is the ——— system used with a fixed-wing aircraft, as well as the Julie system which is coming along as we expected it.

We have done some things in improving reliability of our sonobuoys. We hope with Western Electric and Magnavox we come through with 95-percent reliability.

In the weapons ordnance and fire control we have come along in the weapons system with the Mark 46 torpedo which is pretty well on the road. That is a solid propellent-burning torpedo. We use gases from the propellent to drive the turbines, and it is a ——— knot torpedo and it looks very fine. It is supposed to go into operation in 1963 in the fleet. It is a successor to the Mark 44.

We have come along with the fire control system for the Subroc system in the *Thresher*-class submarine. The *Thresher* is the first submarine where we have made real major efforts in cutting down the noise. She is sound mounted. She has an integrated sonar system with her, and she is due out in 1962.

I understand now it is April of 1961. She is the first of that class.

In the vehicles and propulsion equipment.

In the vehicles we have the hydrofoil, PCH, which is out for bid now, the 110-ton ———-knot ship.

In the propulsion equipment we are looking at the convection-cooled nuclear reactor that Admiral Rickover spoke of.

We are going ahead with related work in the helicopter system using a drone helicopter carrying the 44 with the 46. This is being evaluated now in the fleet and will go on all of our FRAM ships.

In general that covers most of the highlights unless Admiral Bennett has something to add.

Admiral BENNETT. That is it.

Mr. SIKES. Will you provide for the record, if you can do so on a nonclassified basis, a short definition of each of these systems at this point?

(The information requested follows:)

DEFINITIONS

Project ATLANTIS is a study conducted in 1959 to determine the technical feasibility of large ocean surveillance systems.

Project TRIDENT is an exploratory development project assigned to the Bureau of Ships to determine by experiment if the conclusions of the ATLANTIS study are valid.

Project ARTEMIS is an exploratory development of a deep water, long range, fixed antisubmarine detection system.

Variable depth sonar is a sonar that can be towed by a destroyer and its depth controlled by varying the length of cable.

SQS–26 sonar is a large, high-powered low-frequency sonar for surface ships.

SONOBUOYS

JULIE buoy is a buoy that uses an explosive sound source for echo ranging.

JEZEBEL buoy is a passive buoy used for fixing the position of noisy submarines.

TORPEDOES

MK 37–1 is a surface and submarine guided antisubmarine torpedo.

MK 46 is a lightweight, high-speed, homing antisubmarine torpedo.

RETORC II is a research program for advanced torpedo design.

ASROC is an antisubmarine rocket assisted delivery of a weapon from a launching ship to a submarine.

SUBROC is an antisubmarine-weapon submarine, launched underwater to air to underwater.

DASH is a surface ship drone antisubmarine helicopter system for delivery of a weapon to the location of the submarine.

SUBIC is a study of submarine integrated control systems.

SURIC is a study of surface ship integrated control systems.

THRESHER is an antisubmarine nuclear submarine.

PCH is an experimental hydrofoil craft designed to accomplish an antisubmarine warfare mission.

Mr. SIKES. Will you tell me if the present stage of development of each of the systems which you mentioned is optimum or whether there are some of them which show particular promise which should be expedited and could be expedited if more funds were available?

Will you provide that for the record?

(The information requested is classified but has been provided to the committee for their use.)

Mr. SIKES. I particularly would like to know what systems show most promise and which could be expedited if more money were available.

Admiral HAYWARD. All right, sir. I will furnish that for the use of the committee.

Mr. SIKES. And what could be accomplished in the way of expediting the ASW program in each case?

Admiral HAYWARD. Right.

(Classified insert provided the committee.)

EAGLE MISSILE CHARACTERISTICS

Mr. SIKES. What are the characteristics of the EAGLE missile?

Admiral HAYWARD. The EAGLE missile is a solid propellant two-stage missile.

Mr. SIKES. What is its range?

Admiral HAYWARD. We hope to have a range of ———. This is a function of the target. If it is a head-on approach with the AI radar——

Mr. SIKES. How would you use it principally?

Admiral HAYWARD. Against aircraft of all types. It could be used against fighters, bombers, and then air launched stand-off missiles.

Mr. SIKES. Are you not concerned that it is a little late to be developing weapons to be used against aircraft?

Admiral HAYWARD. No, sir, for the simple reason that if you are going to use the surface of the globe, whether land or sea, you still have to have an airplane.

Aircraft will be used in attacks against ships at sea because ships cannot be zeroed in by land based ballistic missiles. You cannot do it with missiles alone, particularly when you are trying to go somewhere with your Marines and a man can come along with a single airplane——

Mr. SIKES. Will this weapon have a capability for use as an air-to-surface missile?

Admiral HAYWARD. We will be able to do this. We did not specify this on our first missile because we wanted to lick the other problem.

Mr. SIKES. What is the type and yield of warhead?

Admiral HAYWARD. Off the record.

Mr. SIKES. The Navy has done an excellent work in developing air-to-air missiles and rockets, possibly rockets more than missiles. This one, quite frankly, leaves me a little cold. I know you are convinced there is a need for it or you would not propose to spend the amount of money necessary to develop this system. Is there such a gap in your defenses that this one is required in addition to all the others that are available in the different services?

Admiral HAYWARD. Actually, we looked at it. As a matter of fact, this was one of the systems extensively examined by the Department of Defense, the Air Force, the Stack Committee, and our concept of going to the subsonic plane was approved. The decision to be made is: What will you do between 1965 and 1970? You had to say either continue with these high speed, real high performance fighters, which are really nothing but a missile with a man in it, or you back off and put your platform in the air and put the performance in the missile. This is why the EAGLE made good sense to us. It is a cheaper system than if you go to the other. Even putting Mr. Flood's 30 percent on it, it is still cheaper than going to the supersonic fighter to replace in that time period.

Mr. SIKES. You already have the supersonic capability, do you not?

Admiral HAYWARD. You have the F–4H a ———.

Mr. SIKES. This appears to be going backward.

(Off the record.)

Admiral HAYWARD. This gives you a much greater kill capability than your other platform does at the speeds and the ranges.

The real secret of this system is the ability to develop the radar, which is the aircraft identification radar, out to ———. As in the submarine business, if you can get that identification out that far, you have to get a weapon to kill him. You cannot do this with the other system.

There is another fundamental thing. We are trying to get the radiation off the surface and into the air rather than on the surface and getting defense in depth. You are putting your actual antiair

warfare way ahead. The surface-to-air missile puts the straight interceptor out of business.

CORVUS MISSILE

Mr. SIKES. What are the characteristics of the CORVUS missile?

Admiral HAYWARD. The CORVUS missile is an air-to-surface missile. ——— The prime contractor is the Temco Aircraft Corp. in Dallas. Actually, it is about 1,700 pounds and it is programed out to ——— miles' distance.

(Discussion off the record.)

When Dr. York reviewed our programs, both Air Force and ourselves, he went along with keeping this one going. This is the only one at the moment that we have under development. It is a problem that I think we have to continue.

MINE WARFARE

Mr. SIKES. Is there a lessening of Navy interest in mine warfare and mine defense measures?

Admiral HAYWARD. Actually dollarwise there was a reduction in effort; yes, sir.

Mr. SIKES. Does that mean the Navy does not consider this field as important as it had heretofore?

Admiral HAYWARD. Yes, sir; it was considered of lower priority.

Mr. SIKES. Why is this?

Admiral HAYWARD. It was purely a defensive system. We have in this budget kept the ASW mine systems up as I covered in my statement. The submarine-moored mine and air-laid mines, we have continued. Actually, the cut on the actual countermeasures was more in the countermeasures against mines rather than in the mines.

Mr. SIKES. Do we already have all the capability we need in the mine countermeasures?

Admiral HAYWARD. As a matter of fact, we have a problem that we have not licked. The ——— is something I do not know how you lick. We have not licked it. We have gone ahead with the Mark 57 mine and the Mark 56 mine and the XG–10 mine in this budget. With the countermeasures, we had $12 million in this budget for mine countermeasures, which is roughly down about 15 percent, I believe.

Mr. SIKES. What do you think the future holds in this field? Is activity going to continue to be reduced or is this about the level you foresee for the future?

Admiral HAYWARD. Mr. Sikes, this is a business that depends on ideas. This is a good place to put some basic research money. I will put $12 million on basic work in this area. If they come up with ideas, we will do something about it. It will be a function of what comes out of the effort in the research field. We do not have any solution now. Even if you gave me more money, I would not know what to do except in the research business of it.

Admiral BENNETT. I would like to add one thing there, Mr. Sikes. One of the things in this area, which I was engaged in for some years, in the countermeasures part particularly, is that we do not have any backlog of new ideas to exploit. For the last 10 years we have been trying to stimulate new ideas.

POLARIS ACCURACY

Mr. SIKES. Is the Navy fully satisfied with the anticipated accuracy of POLARIS? If there is any problem at all about accuracy from the standpoint of launch, knowing where you are when you fire the missile, then it is going to be downgraded in effectiveness.

I think I know what you are going to tell me. I want to know if any continuing studies are in progress to more accurately determine position. I know what you have told us previously. I want to be brought up to date.

Admiral HAYWARD. Off the record.

(Discussion off the record.)

Admiral HAYWARD. Of the shots we have had from the beach, and within the accuracy of the instrumentation, our CEP has been the best so far obtained with inertial guidance systems. POLARIS' CEP under operational conditions, makes it a very accurate weapon. When you look at ——— you take a city the size of Hiroshima, which had 250,000 people in it. When I went in to Hiroshima, there were 70,000 dead people, there were 140,000 casualties, and that was a 13-kiloton bomb. When somebody starts talking about 100 or more times that—how dead can you get? If you dropped such an amount on Hiroshima, there would be nothing.

Mr. SIKES. I am talking about the position of the launching vessel.

Admiral HAYWARD. On the launching side we will be within the requirement. As a matter of fact, Admiral Raborn says he can find his position with great precision; easily within the requirement.

Mr. SIKES. Let me hold you there a minute and go to something I understand. If I am firing a rifle and my sights are off just the least little bit, an eighth of an inch, it makes a big difference 150 yards away where my target is located. This is what I want to know. How can you be sure of your position when you launch the missile?

Admiral HAYWARD. Not only do you have this problem position at sea, but on the land, too. We do not know accurately even in our own United States now where some of the places are, whether you shoot it from here or from a submarine. A ——— CEP means that at least 50 percent of the shots fired will fall in a circle of that radius.

Mr. SIKES. That is reassuring.

SUCCESS OF SIDEWINDER MISSILES IN TAIWAN

Mr. SIKES. I have heard many times that the SIDEWINDER was used at Taiwan a year or two ago when the Chinese Reds were attacking the offshore islands. Is it true that some of their planes were knocked down by Chinese Nationalists using the SIDEWINDER.

Admiral HAYWARD. That is correct. We shot six SIDEWINDERS and got four hits—that is, the Chinese nationalists shot them. This is the first use of an air-to-air missile in actual war.

Mr. SIKES. Are you building in a capability for increased range for SIDEWINDER or for POLARIS with this budget?

Admiral HAYWARD. For the SIDEWINDER, yes; for the POLARIS, no. I testified yesterday about the money for this.

WEAPONS FOR AMPHIBIOUS ASSAULT

Mr. SIKES. I will ask this question for the record and you can answer it for the record. Presumably Marine and Army studies

should coincide on development of amphibious assault capability, dispersed landing capability, vertical envelopment capability. I would like to know whether you are working with the Army on these or whether you are proceeding independently. I would like to know what is in this budget on those particular categories. Provide the answer for the record.

(The answer to be supplied follows:)

DOCTRINE

Navy Marine Corps doctrine for conducting amphibious operations is being coordinated with the Army.

WEAPONS AND EQUIPMENT

(1) Amphibious vehicles: There is mutual interest and exchange of information in pursuing avenues of approach for fulfilling amphibious vehicle requirements for Army and Marine Corps. Marine Corps money in fiscal year 1961 budget to support this development is $2.3 million.

VTOL ASSAULT TRANSPORT DEVELOPMENT

(2) VTOL assault transport to satisfy both Marine Corps and Army requirements is being coordinated by the Department of Defense. Navy budget to support this development in fiscal year 1961 is $2.6 million.

(3) Lightweight helicopter transportable weapons are being developed as joint Army and Marine Corps projects: for example, the 115-millimeter gun boosted rocket. Marine Corps money to support this project in fiscal year 1961 is $263 million.

(4) Liaison between the services is maintained to provide a cross exchange of development information.

LOCATION OF TARGETS FOR BALLISTIC MISSILES

Mr. MAHON. I would like to revert to one of Mr. Sikes' questions. First, I would like to make this comment. To me, it has seemed to be a stupendous problem to try to locate exactly where you are and exactly where another point is many hundreds of miles away. I made a statement that maybe we did not know exactly from Los Angeles where Norfolk is.

My concern was considered as completely unfounded and I was assured that we now have methods of finding out exactly where every place is in the United States and doing a pretty good job overseas.

Admiral HAYWARD. This is correct.

Mr. MAHON. I have very serious doubts about this and you seem to have encouraged my doubts. I am surprised.

Admiral HAYWARD. In the United States we have first order surveys. I would say in the United States you know this. Whereas, we have not cut that survey in with the surveys on the other side of the world. As a matter of fact, this geodetic or geodesy satellite is one way you can do it. I hate to say this, but in my Congressman's home district in Okaloosa County where I live I have a great deal of difficulty finding where my property is. That is in Florida. They assure me they know where it is.

I am convinced, and we have had instances of where things have been not in the position we thought they were outside of the United States particularly because they have never cut in these surveys. Particularly in Siberia and that part of the world I would not say we knew exactly where things were. I agree with you.

Mr. MAHON. Could it be that from some place in Texas or California or Montana or Wyoming where we have ICBM bases—not necessarily in the places I mentioned—could it be that we do not know within a quarter of a mile where a large number of targets might be in an enemy country in the Eurasian Continent?

Admiral HAYWARD. This is a problem that faces us. If they move their missiles to a certain place, I am not so sure we will know it within a quarter of a mile.

Mr. MAHON. Will you know within a mile or two?

Admiral HAYWARD. It will depend. If it is in European Russia, you probably will because we are very fortunate in that after the war we got complete photographic coverage from the Germans. But in some parts of the other sections you would not know. Whether it is off a quarter mile or a mile would depend. If it is on the Trans-Siberian Railway, for instance, some sections of that you would know quite well. For somebody to get up and say, "Yes, I know exactly where it is right down to the last foot," I am very skeptical, as you are. I do not believe it.

Mr. MAHON. Mr. Flood.

Mr. FLOOD. That is not true of the other fellow. He knows about as much where your place in Okaloosa County is as you do.

Admiral HAYWARD. He can get a first order survey.

SUCCESS OF SIDEWINDER MISSILE IN TAIWAN

Mr. FLOOD. You were talking to Mr. Sikes about that dogfight over Taiwan.

Admiral HAYWARD. Yes, sir.

Mr. FLOOD. I do not think you replied to Mr. Sikes' question. You gave him an answer, but that was not the whole answer. I do not believe you gave him the answer he asked for. You know how many planes the Chinese Reds lost over the Taiwan Strait in that scramble.

Admiral HAYWARD. Yes, sir.

Mr. FLOOD. Four of them went down with SIDEWINDERS.

Admiral HAYWARD. That is correct.

Mr. FLOOD. The rest of them were shot down because the Chinese Nationalist pilots had 2,000 hours in the air and the Chinese Red pilots had 90 hours in the air. The Chinese Nationalists pilots are red hot pilots.

Admiral HAYWARD. Well trained.

Mr. FLOOD. When the story went out of Taipei about this tremendous SIDEWINDER victory, that was nonsense. There was no tremendous SIDEWINDER victory. You shot six of these pigeons, they knocked down four Reds, and you missed two. The rest of them were shot down by red hot Chinese Nationalist fighter pilots.

Admiral HAYWARD. Mr. Flood, they only had six missiles, and when you get four hits out of six shots in any kind of shooting, I say this is good shooting.

Mr. FLOOD. I am not talking about that. I am talking about the story that came out of the Pentagon, which told the world that you shot down 1,100 Chinese Red pilots with 1,100 SIDEWINDERS. That was for the birds.

Admiral HAYWARD. I agree.

Mr. FLOOD. Just a little poetic license.

Admiral HAYWARD. That was not out of the Pentagon. It never would happen in the Pentagon.

Mr. FLOOD. No; they would have made it 2,200. That is the kind of thing that you need a very elastic sense of humor for up here. Most unfortunately for you fellows, every once in a while some members of this committee turn up at these places, very embarrassing.

Admiral HAYWOOD. No, sir; I do not think so. That is good for us.

Mr. FLOOD. I agree.

WEATHER AS A WEAPON

Are you engaged in any bona fide, serious R. & D. work to use weather as a weapon in any way whatsoever, either rain or snow or lack of it, or attack against crops, plus or minus, or anything?

Admiral HAYWARD. Not as a weapon, Mr. Flood. We are doing a lot of work on trying to actually do something about weather forecasting and knowing what the weather is. For instance, the ARCAS and ARCON rocket business. We are not trying to use weather as a weapon, no serious effort in this line.

Admiral BENNETT. I would like to add this one thing. On this line of influencing weather, not necessarily using it as a weapon, there has been recent seeding of clouds with carbon black and that is most promising for purposes of producing rain.

Mr. FLOOD. I have always been curious about utilization of air currents for CBR warfare or for any other kind of operations at high altitudes like the Japanese did with those fire balloons into the northwest area of the United States in World War II taking advantage of prevailing winds, et cetera. Are we curious about that? How can we use it? To what extent are any of your long-haired people looking at it?

Admiral BENNETT. I will answer that at least in part, sir. This was one of the purposes of a good deal of work going into constant altitude balloons, with which quite a few experiments have been done in the past and in which we have the mechanism for continuing at any time it appears necessary to use the balloon-type vehicle.

USE OF BERYLLIUM

Mr. FLOOD. What are you doing in the area of your missiles people with beryllium?

Admiral HAYWARD. Beryllium is used in the reentry body.

(Discussion off the record.)

Admiral HAYWARD. As I previously stated, it is being used in the reentry body of POLARIS. It is being used in parts of the inertial systems in our guidance systems and SINS systems in the submarines because beryllium has low inertia. This is a very good use of it.

We also use it in any system requiring low inertia such as shutters for cameras.

Admiral BENNETT. One thing should always be mentioned in connection with beryllium, which is its toxicity.

Mr. FLOOD. You mean a high toxicity?

Admiral BENNETT. Very high toxicity. For example, there is a building in Boston which was used during the war which has to be torn down because it cannot be cleaned to be made safe.

Mr. FLOOD. I was going to raise that question of toxicity.

Admiral HAYWARD. This is a problem. Let me say what we are trying to do.

(Discussion off the record.)

Admiral HAYWARD. Aerojet and a small corporation, Rocket Power, I believe it is, feel that they can do this on an experimental basis safely.

Mr. FLOOD. What is the potential of this stuff in structural work for aircraft or airframe? What about your research? You have been talking to me about your trouble, all the R. & D. boys, about this low or high fracture point, depending on which way you look at it, on beryllium and its potential for structural use. There is a low fracture point.

I have been hearing that for years. Is it still as bad as it was?

Admiral HAYWARD. Yes, sir, it has practically been disregarded for structural material for aircraft.

Mr. FLOOD. It has?

Admiral HAYWARD. Yes, sir.

Mr. FLOOD. First I heard of it. It is so desirable for that purpose.

Admiral HAYWARD. It is desirable. Research people are still trying to do something in this line. They are also trying to do something in it because the same problem is faced in the reactor. If we could use beryllium for structural material, we would be better off also.

Mr. FLOOD. What I have in mind is your progress in nuclear propulsion for aircraft. If you can use beryllium in any way to lighten this operation and get by that fracture point—do you have a metals man here in your backup men?

Admiral HAYWARD. I can talk to the nuclear propulsion side of it where we have gone to lithium-columbium cycle with Pratt & Whitney.

Mr. FLOOD. This beryllium has such potentials in two areas, so highly desirable for structural work and so equally highly desirable as a ———.

Admiral HAYWARD. Off the record.

Mr. FLOOD. This does not mean much in our hearings, but one of you fellows was talking about low altitude winds causing us more trouble than high altitude winds. You were speaking of the Caribbean. All I could think of was Castro. Which altitude would he be? You were talking about Caribbean winds.

Admiral BENNETT. I was not talking about low-altitude winds. I was speaking specifically to what is loosely talked of as the jetstream. That is the very high-altitude winds over a hundred thousand feet.

Mr. FLOOD. That is just my perverted sense of humor that gets worse as the months go on.

Admiral BENETT. I understand.

U.S. RESEARCH COMPARED WITH EUROPEANS

Mr. FLOOD. In the war years the British told me that they were the best there was and that they thought up sonar and radar and everything else and you fellows borrowed it from them. How close are we working with the British on this radar and sonar business?

Admiral BENNETT. This is a canard. They did not invent sonar; a Frenchman did.

Mr. FLOOD. It might have been a Norman. That gets the British mixed up. Add the French into this. What about the whole package on sonar?

Admiral HAYWARD. Our R. & D. program is integrated with the Canadians and the British. At the moment they know exactly what we are doing and we know exactly what they are doing. We keep in pretty close touch with them. We have under the NATO sponsorship a NATO Naval Steering Group which includes all of the countries. On these items they meet once every 3 months and discuss all the programs. Now the La Spezia effort, an ASW technical center, the second man in technical charge there was the second man in the Portland Underwater UDE establishment in the British admiralty. The No. 1 man is an American, Dr. Booth. We are all together there in La Spezia and they are completely invited into the family as far as what we are doing. We cannot do this with all those countries, however, because we have security problems.

Mr. FLOOD. I was thinking of just radar and sonar. There is a lot of talk in Europe, I have sat around, I have heard it, that there is a great similarity between the Americans and the Japs. You can never think up anything, but you can get hold of something and run with the ball and make everybody else stand still, but you cannot think it up.

Admiral HAYWARD. That is pretty much European propaganda.

Mr. FLOOD. I remember the debates 10 or 12 years ago, talking about the National Science Act. Congressman Priest was handling the debates. It was pretty generally the motif of that whole debate that we do not have such an extraordinary record vis-a-vis the nations of the world in pure science.

Admiral HAYWARD. You are correct.

Mr. FLOOD. We get it on the first bounce and nobody can touch us from then on in and the Japs get it on the second bounce and nobody can touch them from then on in, but as far as being present at the accouchement on these things, we are not quite as hot as the American people are convinced on these things.

Admiral Bennett. I can produce statistics of recent years to dispute that.

Mr. FLOOD. Very recent.

Admiral BENNETT. Twenty years. One example would be the Nobel prize winners.

Mr. FLOOD. Twenty years is pretty young in this.

Admiral BENNETT. We are just growing up in this country.

Mr. FLOOD. That is the point.

Admiral HAYWARD. From 1951 to 1958 the United States had 47 Nobel prize winners, the United Kingdom had 20, France had zero, Germany had 7, roughly the rest of the countries are very low. This is recent. Before 1932, before Fermi came to this country, yes. When Fermi came to this country, we began to go the other way.

Mr. FLOOD. It is a bad idea, not good in one sense, and it is an Achilles heel of a sort to have the people think we are so good at everything and you wake up Sunday morning and you are not, and that is very embarrassing and that causes casualties. A lot of people get hurt when you do not have the right ideas.

Admiral HAYWARD. Incidentally, from 1951 to 1958 Russia had 13 Nobel prize winners. They are coming up also.

Mr. FLOOD. Yes, and they had them a long time before you had them, and very good ones.

Admiral HAYWARD. Not Nobel prize winners.

Mr. FLOOD. No; not Nobel prize winners, but in pure science and mathematics and very long-haired advanced areas they are not square-headed peasants and have not been for a long time.

Admiral HAYWARD. They have not been since Mendelyeev.

FLEET DEFENSE AGAINST CHEMICAL AND BIOLOGICAL WARFARE

Mr. FLOOD. What about CBR defense on your operational fighting ships with the fleet in the R. & D. area? I know what you have, but what is R. & D. doing about CBR defense 8, 10, 20 years ahead? On this carrier you are going to be operating in 1984 or something like that, what will the CBR defense be on this new carrier 26 years from now. That is, besides soap and water.

Admiral HAYWARD. Water is very good.

Mr. FLOOD. It is handy, right alongside.

Admiral HAYWARD. We have reviewed the whole CBR, CW, the whole business with Dr. York and the services. We sat down and went over all the agents that were available and what they thought would be available in the 1965–70 era and on.

Mr. FLOOD. You stopped it. What are you doing?

Admiral HAYWARD. When we looked at the agents and everything, Dr. York asked us to consider whether we should not go ahead and do it now with specific agents that the scientific fraternity is going to pick to use.

Mr. FLOOD. This will be of advantage to the great merchant fleet, too.

Admiral HAYWARD. It will be of advantage to everybody because you cannot possibly do this ashore, to start with, so you should do this in an area where you think you are not going to hurt somebody else.

Mr. FLOOD. It would occur to me that on the threshold of a war that you say will be atomic war and your whole budget is directed toward atomic attack, it would occur to me you would spend some serious time upon atomic defense for the fleet at sea, and it is curious that this has not been advanced much further.

Admiral HAYWARD. Dr. York has set this group up to really look at it early this fall, because we found out that the Russians, and this statement I have never been able to validate, were putting as much as ——— of their defense budget in this field of CW and BW work, not specifically defensive but offensive.

Mr. FLOOD. Our information is that on the line in West Germany today ——— of the operational arsenal in the field with troops and ammunition is chemical warfare now, for 2 years, on the line. Ours is ———

(Discussing off the record.)

Admiral HAYWARD. We are going to go ahead from the Navy's point of view with this program of actually doing it at sea. The Army does the actual agent business. We are not in the business of doing the

chemical work for this. We are doing the biological work with the Army.

(Discussion off the record.)

Mr. FLOOD. That is decontamination on the beach?

Admiral HAYWARD. They have the only attack capability.

Mr. FLOOD. I am concerned about what happens to the fleet, a task force, under atomic attack. Nothing, apparently.

Admiral HAYWARD. If it is an atomic attack, I am not as worried as I am——

Mr. FLOOD. I do not mean blast and fire, but radiation.

Admiral HAYWARD. From the radiation point of view, we can do fairly well in the decontamination field.

TYPHON MISSILE

Mr. FLOOD. On page 14 of the Secretary's statement he talks about TYPHON. You have ——— you are asking for in the project listings, the second biggest dollar request for your special shows after EAGLE. You are asking for a big chunk of money out of your whole priority shopping list. TYPHON is supposed to be this, and I quote from the Secretary's statement:

> TYPHON will provide an increased range and altitude capability—

here I do not understand—

> will be effective against submarine-launched ballistic missiles.

Is TYPHON a defense against ballistic missiles? Is this another NIKE-ZEUS?

Admiral HAYWARD. No, sir; an entirely different approach. The place to shoot a ballistic missile down is when it is coming up out of the sea. It could track and shoot down this missile at that part of the trajectory.

Mr. FLOOD. Knocking down one bullet with another bullet?

Admiral HAYWARD. Yes, sir.

Mr. FLOOD. You interest me.

Admiral HAYWARD. I have to have some capability on this. What do I do, send a wire home and say it is on its way?

Mr. FLOOD. That is my argument on behalf of NIKE-ZEUS. I am glad you are on board. This is the first I have heard the Navy was going to shoot down a bullet with a bullet and asks ——— million, the second highest number on this shopping list after EAGLE. Not a word has been said about it by anybody all year.

Admiral HAYWARD. Mr. Flood, last year and the year before this came up. Actually, the TALOS missile was looked at by SAC with the radars which are now being used by the Army on the American Marines to use as a ballistic missile defense at SAC bases. It does have some capability of doing this. It did not make good technical sense to try this.

Mr. FLOOD. I would like you to develop on the record at some reasonable length what the Navy is doing on this knocking down one bullet with a Navy bullet and how long you have been at it, what you hope to do, how much you have spent at it, how much you want to spent on it. You are not fooling with ——— million.

Admiral HAYWARD. That is right.

(A classified statement was submitted.)

HARBOR DEFENSES

Mr. FLOOD. Let me read these questions in and you may answer them for the record. Harbor defenses and antimine warfare with reference to the harbor defenses.

(The answer is classified and has been provided to the committee for their use.)

DEVELOPMENT OF RESEARCH AND DEVELOPMENT TOOLS AND EQUIPMENT

Mr. FLOOD. Tell us to what extent the Navy designs and creates and invents and manufactures and produces its own working tools, the very R. & D. hardware with which all R. & D. Navy people work. Where do you get your hardware? Do you make it, design it, buy it at Woolworth's? How good are you at hardware that the R. & D. people use?

Admiral BENNETT. The working tools or hardware with which the Navy R. & D. technical personnel do their work in Navy laboratories come from several sources. The majority of the items used such as an oscillograph are purchased directly from contractors as off-the-shelf items. Another type of "tool" such as a wind tunnel would normally be designed and built under contract with private industry to specifications prepared by Navy technical personnel. The last source would be cases where highly specialized equipment not available on the open market would be designed by Navy technical personnel and fabricated in Navy laboratories. An example would be a special strain gage used to measure stresses in structures under high temperature conditions.

The Navy obtains the major portion of this R. & D. hardware from private industry either as an off-the-shelf item or by special order. However, when Navy sources must be utilized to design and fabricate R. & D. hardware, naval technicians have demonstrated the ability and ingenuity necessary to produce the needed equipment.

ALTERNATE HEADS FOR SIDEWINDER

Mr. FLOOD. I want to know something about the alternate heads, IRA and SARAH, on the SIDEWINDER, the infrared and radar interchange of warheads on the latest generation of SIDEWINDERS.

(The information is classified and was supplied to the committee.)

TESTS AND SELECTION CRITERIA FOR ASTRONAUTS

Mr. FLOOD. I want something on the psychological and physiological tests and neuropsychiatric surveys and tests on the nuclear submarine crews and space people, naval and air medicine.

Dr. GALLOWAY. The Navy has participated fully with the other military services and the National Aeronautics and Space Administration in the development of psychophysiological tests and other selection criteria for the Mercury astronauts. Four of the selected Mercury astronauts are naval and Marine Corps officers. The Navy feels that the psychological selection tests which have been developed and utilized for the selection of aviation, submarine, and other special categories of naval personnel contain elements which, through modi-

fication, can be adapted to the selection of astronauts. In addition, the Navy has been studying the records of the already selected astronauts to determine those peculiarities in their backgrounds which may be of value in future selections. The Navy has developed Project Astronaut at the Naval School of Aviation Medicine in order to extend procedures for identifying a pool of well qualified volunteers from which future astronauts may be selected.

As a result of a longitudinal long-range study of the life history of naval aviators which has been in progress for 15 years, a mass of physical data is available which serves as a baseline criterion for the physical selection of best qualified candidates. Other studies have resulted in constant refinement of the physical selection test battery.

In addition, the Navy possesses a wide variety of special devices that have already been used which will increasingly be used in the future to determine particularly desirable physiological parameters. The human disorientation device, human gradient calorimeter, vibration test device, world's largest centrifuge-computer complex, rotating room, space simulation training chamber, and the unexcelled background which the Navy possesses through its submarine experience results in a capability for the selection of astronauts which is unique. The Mercury astronauts have stated that their experiences with the dynamic flight simulator on the Johnsville centrifuge has been the most realistic and worthwhile training which they have experienced.

The Navy has developed a training capability in all aspects of survival. This capability will be enhanced by the experience gained in planning for and executing of the medical aspects of the recovery phase of Project Mercury, a mission which has been assigned to the Navy.

The Navy has geared its entire medical research program to the solutions of problems resulting from man's exposure to stressful and exotic environments. This program runs the entire gamut from the most fundamental basic research to the development, test, and evaluation of practical devices for operational usage.

The current personnel selection program for service in submarines is based on a battery of psychological tests dealing with attitudes, motivation, and judgment of the prospective crew members. In the case of personnel selected for nuclear submarine service, this battery of tests is now further supplemented with additional objective and subjective psychological tests and extensive personal interviews which were developed specifically for the conditions of service which obtain in nuclear submarines. Testing and selection utilizes (*a*) the personal inventory barometer (PIB Form 3) of 100 statements on which the individual rates himself, and (*b*) the self-motivation questionnaire (SMQ Form 2) of 50 statements dealing with factors influencing an individual in volunteering for submarine service. For nuclear crews these tests are further augmented by standard psychodiagnostic record booklet; personal history; parental, developmental, educational, vocational, and aspirational forms. A modified SMQ is utilized to fit personnel already in submarine service who apply for nuclear service. Further procedures include a health questionnaire complementing previous medical history and physical qualifications; personal psychiatric interviews; and individual psychological examination, including standard projective techniques which can be correlated during

course of an individual's service. All of these test batteries and interview formats are subject to continuous improvement as may be indicated by fleet performance validation and feedback. The overall purpose of the program is to assess the individual attitudinal structures which will result in maximum cohesiveness of a submarine crew under conditions of long submergence.

Mr. MAHON. While you are supplying information, give us the breakdown of precisely what you are doing in research and development in connection with the humanities.

Admiral BENNETT. No research and development effort is being conducted by the Navy in connection with humanities.

Mr. MAHON. Mr. Ford

OBLIGATIONS

Mr. FORD. Admiral Hayward, most of the projects in which I was personally interested have been fairly well covered by other members of the committee. I am, however, always interested in what you tell the committee each year, both as to your program and as to your appropriation request, and how you execute it as we see the picture the next year.

Last year in submitting the budget for fiscal 1960, the 1960 estimate for total direct obligations was $968,756,000. As I look at the green sheets before me for fiscal 1961, there is a column for fiscal 1960 which indicates that for total direct obligation in fiscal 1960 you will have $1,251,139,000. There is a difference between what you requested last year and what you are executing at the present time of approximately $283 million. What is that difference?

Admiral HAYWARD. That difference comes from the carryover and transfers that have come for the test and evaluation as discussed with Mr. Sheppard. The $283 million is the difference between the $1,251 million and the $968,756,000. Is that the question?

Mr. FORD. What I want to know is, How come there is a difference? I know there is a good explanation but we ought to have it on the record.

Admiral HAYWARD. I will furnish it for the record and break down that sum into details.

Mr. FORD. Explain it so we have it on the record.

(The information to be supplied follows:)

Comparison of fiscal year 1960 obligations in the fiscal year 1960 congressional budget with fiscal year 1960 obligations in the fiscal year 1961 congressional budget

Fiscal year 1960 obligations in fiscal year 1960 budget	$968, 756, 000
Congressional add-on	45, 000, 000
Comparative transfers	256, 561, 000
Transfer to other accounts	−5, 500, 000
Decrease in planned obligations resulting from an adjustment in carryover balances	−13, 678, 000
Fiscal year 1960 obligations in fiscal year 1961 budget	1, 251, 139, 000

Mr. FORD. I have the same question in reference to new obligational authority. Last year the budget plans indicated you were going to have new obligational authority of $970,920,000. The green sheets before us now for fiscal 1960 indicate that you will have new obligational authority in fiscal 1960 of $1,010,420,000. Will you explain

that difference for the record so that we can have the information before us.

(The information to be supplied follows:)

Comparison of fiscal year 1960 NOA in the fiscal year 1960 congressional budget with fiscal year 1960 NOA in the fiscal year 1961 congressional budget

NOA request in the fiscal year 1960 budget	$970,920,000
Congressional add-on for ASW	+45,000,000
Fiscal year 1960 NOA approved by Congress	1,015,920,000
Less actual transfer for classified project	−5,500,000
Adjusted fiscal year 1960 NOA in the fiscal year 1961 budget document	1,010,420,000

EXPENDITURES

Mr. FORD. Could you also show what you planned to spend last year when you came before us, for fiscal 1960, and what you expect to spend now that you are executing the program in fiscal 1960?

Admiral BEARDSLEY. Do you want that in actual expenditures?

Mr. FORD. That is right; what you actually planned to spend in this area and what you actually are spending in this area.

(The information to be supplied follows:)

Our present estimate is $50 million higher than last year's estimate when a comparable basis is used. The following schedule gives the details of adjustments made.

Comparison of fiscal year 1960 expenditures in the fiscal year 1960 congressional budget with fiscal year 1960 expenditures in the fiscal year 1961 congressional budget

[In thousands]

	Expenditures from appropriated funds	Comparability adjustment	Total
Fiscal year 1960 expenditures anticipated in fiscal year 1960 budget	$823,000	$98,815	$921,815
Adjustment in POLARIS expenditures to current operating plan	−120,000		−120,000
Additional comparability adjustment for T. & E. transfers		278,718	278,718
Increase in expenditure estimate	50,000		50,000
Fiscal year 1960 expenditures anticipated in fiscal year 1961 budget	753,000	377,533	1,130,533

FISCAL YEAR 1960 AMOUNT OBLIGATED

Mr. FORD. What is your obligation picture in this program as of your last reporting date?

Mr. WARSING. Mr. Ford, we have obligated through the month of February 65 percent of our program or $654 million.

Mr. FORD. What did you actually get in obligation authority for fiscal 1960?

Admiral ENSEY. $1,010,420,000.

Mr. FORD. Against which you have obligated as of February 29, $654 million. Which is 65 percent of the NOA which was made available?

Mr. WARSING. That is correct, sir.

Mr. FORD. Are there any unapportioned amounts?

Mr. WARSING. There is an amount of $61,805,133 which we may commit but not obligate, sir.

Mr. FORD. Which will be carried over for obligation into fiscal 1961?

Mr. WARSING. That is right. This is under our currently approved financial plan.

Mr. FORD. What did you anticipate last year as a carryover of unobligated balances?

Admiral BEARDSLEY. Between $19 and $20 million, on the average, however last year was $30 million.

Mr. FORD. There is a slight amount of carryover beyond what you programed for a year ago.

Admiral BEARDSLEY. Currently planned that way, although it is hoped that in the latter part of the year we will be able to increase our obligation plan and reduce the carryover. OSD has indicated a willingness to review that with us.

OPERATION SKYHOOK

Mr. FORD. Admiral Bennett, last year you talked about this balloon operation, Skyhook. We have been reading news stories about it. I am sure from reading your testimony last year that it is a very vital program.

I get the impression that the public wonders why we are fooling around with balloons when the Russians are concentrating rather successfully with space programs. Why are we working on balloons?

Admiral BENNETT. There are two fundamental reasons. One is that the balloon altitude is so low that it is not possible to fly satellites there. They would burn up. The other reason is that for this altitude or for any altitude you can reach with a balloon the cost is much less. As I testified yesterday, for example, in this 125,000-foot experiment with cosmic rays, which is far enough outside of the normal earth's atmosphere to get all the scientists desire, the balloon itself costs $7,500. I do not know what a satellite costs today because I am out of that business, but it is several million dollars, I am sure.

Admiral HAYWARD. $4 million just for the THOR.

Mr. FORD. From a scientific point of view, how does the information you get from these kinds of operations compare with the scientific information they get from a satellite?

Admiral BENNETT. It is much better for this purpose. It will be a long time, for instance, before you get pictures of the sun which in any degree compare with those taken with an actual camera and telescope, which was done this last year.

Mr. FORD. Do we have any information that the Russians are using the balloon technique for any information?

Admiral BENNETT. As far as I know, they are not.

Mr. FORD. That is all, Mr. Chairman.

Mr. MAHON. As was stated earlier in the morning, Mr. Laird and Mr. Lipscomb, at the request of this subcommittee, spent considerable time and energy making a study of antisubmarine warfare late last year. Quite a number of questions have been asked with respect to the antisubmarine warfare program and many of the things in which

they have been interested have been presented for the record or have been given to the committee off the record during our hearings over the last few weeks. I am going to ask Mr. Lipscomb if he has any further questions at this time.

DEFENSE AGAINST NUCLEAR SUBMARINE THREAT

Mr. LIPSCOMB. Admiral, in developing your ASW program, has it been determined whether or not you are developing your program toward a strong Soviet nuclear sub threat or is the program still being developed toward conventional submarine threat?

Admiral HAYWARD. Primarily it is against the deep nuclear submarines that we are really concerned. In most of our weapons, detection, things of this kind, our requirements are based on this. We do not have any specific answers to all of it.

For instance, take the MK–46 torpedo. It is being programed to be used at ——— feet. Acquisition range is longer, speed is higher. This follows in the rest of the fields. This is the real problem.

The present Soviet submarines are primarily conventional ones, and are not true submersibles. I feel this problem can be solved, whereas, we do not have the solution to the other at the moment.

Mr. LIPSCOMB. If this was found out through intelligence or otherwise that the Soviets were going into a nuclear submarine program, a large one, would it make a difference in your ASW plans?

Admiral HAYWARD. I do not think it would make any difference in the research and development area. It might make a difference in the mix of, for instance, the number of atomic depth charges you had and things of that kind. You might buy more of one or you might hold off on buying some and wait for the later one. Offhand, in the R. & D. program I do not think it would change it.

Mr. LIPSCOMB. You are not prepared at the present time for a nuclear Soviet threat either in weapons or other items that are necessary in this regard?

Admiral HAYWARD. That is essentially correct. In the research area we just do not have the solutions we need to the whole problem. In classification we are doing work in the magnetometer field which will be very applicable. In the localization we are doing work in it that would be applicable. In the weapons we are doing the same thing. In the vehicles, in the *Thresher* class submarine we are doing work that is primarily directed against that nuclear threat, but it is not actually in being now and will not be for several years.

FALLACY OF WAITING FOR A BREAKTHROUGH IN ASW

Mr. LIPSCOMB. During our study one of the complaints we heard as we went around was that it seemed to some that the Navy was holding back on certain areas of research and development because they were waiting for some breakthrough. These people that had this complaint felt this was a mistake, that we did not concentrate our efforts in areas that we knew something about and had an end item that would be of value in any submarine threat. Do you think this is a valid complaint?

Admiral HAYWARD. No, because I feel, as we stated before, Mr. Lipscomb, that there was not going to be any breakthrough that is going to solve the problem. It is going to be a nasty thing from now on. There are going to be many things you have to do. There is no easy solution. I do not know of anything that we have held up because we are waiting for a breakthrough. That term has been beaten to death, of course.

There is no easy solution. If you ask me today what is the one thing that would make the problem simple, I could not give it to you because it is a very complex situation which requires all three types of vehicles: it requires a variety of weapons and requires all the ancillary equipment to make those vehicles and weapons effective. I do not know of any we have held up waiting for breakthroughs.

PROGRAM FOR DEVELOPMENT OF DETECTION EQUIPMENT

Mr. LIPSCOMB. There is no change in your program or plans that does not recognize that the primary problems of this whole area are, one, detection and localization, and, two, classification and identification, is there?

Admiral HAYWARD. No, sir. That is the No. 1 problem on the Hit Parade. I furnished Mr. Laird, and the committee has this, the breakdown on what we think is required. We break those areas of classification, detection, localization, then weapons, ordnance and fire control, then vehicles and propulsion equipment, then you get the collateral supporting and related equipment to those areas, but that is the order in which you would proceed.

Mr. LIPSCOMB. I notice in the analysis of your program which you have presented to the subcommittee that in areas such as radar and sonar and sonobuoys there seems to be a reduction in those items from 1960 to 1961, not in all cases throughout the program, but in a great many of the cases you are reducing the amount requested for radar, sonar, and sonobuoys. Is there a reason for this?

Admiral HAYWARD. On the R. & D. side of it?

Mr. LIPSCOMB. I will take one item. It is on the first page of this analysis. It is for sonars, DOD class 1–R. Planned objective is AS. Fiscal year 1960 is $19 million. Fiscal year 1961 is $9.8 million.

Admiral HAYWARD. Yes, sir. In the 1960 NOA you have the $45 million cranked into that $19 million you have. It is down in 1961.

The justification for the difference is in your other book. We addressed ourselves to these differences. Admiral Bennett addressed himself to all those differences on the record, Mr. Lipscomb.

Mr. LIPSCOMB. Is this a reduction in your sonar and radar program?

Admiral BENNETT. As far as the sonar part of this particular item referred to, Mr. Lipscomb, this is largely caused by the completion of a phase of Project Artemis. This does not mean Artemis is completed, but that the equipment for the research and experimentation will be at a point where it is necessary to do something about the use of the research equipment before proceeding with large expenditures.

I am not sure I have this particular information as to this specific item on radar. This is a large classification.

Mr. LIPSCOMB. All through this material in this book there are a great many items of sonar, radar, and sonobuoys that have been substantially reduced. Evidently what you are saying is that the add-on money that this committee gave to the Navy last year was applied in 1960 fiscal year, at least proposed to be applied, and that the 1961 year you are going to cut down and not ask for additional money to keep this program at the level that you felt was necessary this year.

Admiral HAYWARD. Mr. Lipscomb, maybe I can answer that. In preparing this budget, the overall program, I went forward to the Secretary of the Navy with what I considered we needed in these fields. I was given my budget guidelines and this is what eventually came out.

Under the true requirements that I went on record for in this particular field, I asked for $152 million vice the $63 million that I got in it. This was in the Navy and, as you know how the budget is prepared, the guidance I got, I abided by it.

Mr. MAHON. Will the gentleman yield?

Mr. LIPSCOMB. Yes.

Mr. MAHON. Are you saying yes to his question? Are you saying that Mr. Lipscomb is correct?

Admiral HAYWARD. Yes; I am saying yes to his question, that the $45 million was used as a one-shot thing and we went back to the $180 million, which was roughly only $4 million over what it had been in 1960. I am answering yes.

ALLOCATION OF FUNDS

Mr. MAHON. Is the Navy more or less giving lipservice to the acceleration of antisubmarine warfare and asking for other programs such as EAGLE and MISSILEER; is that right?

Admiral HAYWARD. I do not agree with that.

Mr. LIPSCOMB. That is the point I wanted to get to. It appears to me in looking this over that you have taken your budget request for 1961 and applied it on other items of not the top priority, as I see it, and reduced what we feel or I feel is top priority items and programs—maybe this is unfair to say—with the hope that this committee will again give an add-on because of the priority we put to this program.

Admiral HAYWARD. No, sir; that is not correct, Mr. Lipscomb. We cannot present a budget where we hope you are going to give us an add-on. When you say we are just giving lipservice to it, this is not true either.

Going into the fleet this year as a matter of record, we have the following equipments that have been produced—expedited. You have your RDT on the SQS4 sonar, variable depth sonar, SQS23, evaluation of the SQS26, passive submarine equipment, noise reduction programs, you have improved communications, you have the Mark 44 torpedo, you have the Mark 45 torpedo, you have the Mark 57 mine, you have JULIE-JEZEBEL and ASROC going in this year. This is not a small sum of money.

People use ASW particularly narrow out here. The only reason you are going to be able to do ASW in some waters is because you can

fly around with immunity and do your job. If you do not control the air, people say the EAGLE, for instance, competes against ASW. What are you going to do, give up everything except where we control the air from the shore? You cannot do this. ASW is a concept where you have to employ all the means you have—air, surface, and submarine—and tie them together as a team.

This particular budget you see here is the R. & D. effort in it. I think under the guidelines I got that it was a balance and it is a good effort and not just lipservice.

As a matter of fact, our technical directors of all our Government laboratories, who looked at the 1961 budget and came in with ideas that they thought might be done, could only come up with ideas totaling $17 million that they thought should be done. They are the people who would have to do the work, who have the responsibility and the authority. It was a well thought-out $17 million worth of items which we certainly hope to do.

Mr. LIPSCOMB. $17 million worth of new items?

Admiral HAYWARD. Additional items that were not in the 1961 budget. Dr. Hartman presented that for all the laboratories, and it is a very sound program he presented. They have to do the work, so it is very honest. They know what they can do and what they cannot do.

Mr. LIPSCOMB. I understand Mr. Laird covered the laboratory situation.

Admiral HAYWARD. Yes, sir.

DEVELOPMENT OF HYDROFOIL

Mr. LIPSCOMB. I understand there is money in the budget for research, development, tests, and evaluation in the hydrofoil craft.

Admiral HAYWARD. Yes, sir.

Mr. LIPSCOMB. Which is proposed as an ASW weapon. In a matter such as this, how does the Navy or your Bureau cooperate with other research and development organizations throughout the Defense Establishment in determining whether or not you are duplicating each other or both trying for the same solution and both working separately toward that solution?

Admiral BENNETT. Are you speaking particularly of the hydrofoil?

Mr. LIPSCOMB. Yes, in this case.

Admiral BENNETT. I can speak to that one. This is not only well coordinated within the Department of Defense but also with the Maritime Administration. We have assisted them in laying down the specifications for their experimental hydrofoil craft. I believe this program is well conceived and well coordinated across the entire Government.

Admiral HAYWARD. I sit with Dr. York on the Research and Engineering Policy Council, which consists of myself, General Trudeau, and General Wilson and the three Assistant Secretaries. The programs are reviewed by all of them. I know the Air Force program and he knows my program. The same way with the Army. Through Dr. York's office all of this research and development effort is coordinated.

Mr. LIPSCOMB. Do you have a prototype of a hydrofoil craft?

Admiral HAYWARD. There is a 100-ton ship out for bid now with variable depth sonar, ——— knot speed. We should have that sometime in June. The contract should be awarded then, and that is going ahead as an ASW craft.

Mr. LIPSCOMB. I have a clipipng out of a national magazine of a picture and an advertisement about one of the companies which built a hydrofoil craft for the U.S. Army Ordnance Corps.

Is this program coordinated completely with yours? Are you looking for different solutions from the Ordnance Corps hydrofoil?

Admiral HAYWARD. We know about their program. We have a different problem. We have an entirely different set of demands on the hydrofoil equipment that we want. They have taken work that our people did in the Bureau of Ships and in the Office of Naval Research on hydrofoil in this particular craft of theirs.

Mr. LIPSCOMB. I hope we are not spending money in a dozen different directions to get the same solution.

Admiral HAYWARD. No, sir.

Mr. LIPSCOMB. That is my concern in this particular matter, and in all R. & D. for that matter.

Admiral HAYWARD. For instance, in Mr. Flood's questioning about the amphibious vehicles, the Army does that work. We get the LVT's from their setup. We are working very closely together with the other services in the R. & D. program.

Mr. LIPSCOMB. In this study that Mr. Laird and I made, I am convinced that the ASW is one of the serious problems we have to face up to in our defense posture.

I just hope we are giving it the priority that is necessary and the attention that is necessary. I know all the testimony we have accumulated is beginning to show that, and I hope we have evaluated the entire picture completely.

I for one am willing to support a properly directed program and support the appropriations so we can have the necessary ASW defense posture.

PROMOTION OF ADMIRAL BEARDSLEY

Mr. MAHON. Admiral Beardsley, are you to take a new assignment here soon?

Admiral BEARDSLEY. With the approval of the U.S. Senate, sir.

Mr. MAHON. What will be your new job?

Admiral BEARDSLEY. To relieve Admiral Clexton as Chief of Naval Materiel, upon his retirement, about the 1st of July.

Mr. MAHON. I would like to say that in my judgment the Navy is moving in the right direction on this matter, and I would like to commend you for the fine cooperation you have always given the Navy and this committee.

Mr. FLOOD. We will provide the admiral with the customary wound stripes and battle stars for service before this committee for his "fruit salad."

Admiral BEARDSLEY. It has always been a pleasure to work with this committee, sir.

Mr. FLOOD. We have been very fond of you. It amazes me.

Mr. LAIRD. We have gone into the antisubmarine warfare program at some length this morning. What is in this budget to meet another problem that has to do with countering the Russians in their antisubmarine warfare work?

It seems to me that in that particular area we are always looking for big expensive programs when this can be done rather cheaply.

Admiral HAYWARD. Of course, we would like a perfectly silent and quiet submarine to defeat their ASW. We are going ahead with the *Thresher* class submarine, as I told you, in the noise reduction program.

We are also trying everything we can to up the speed at which our submarines can really employ their sonar effectively.

We are going ahead with the natural circulation reactor to cut down the noise. We are trying to get in the research area in the thermoelectric conversion. If we could make a device whereby we can take the heat and convert it directly to electricity and run an electric motor, we would be able to have a pretty quiet submarine.

In the *Albacore* conversions we are having ——— batteries in there and a ——— shaft horsepower electric motor. We will have some other features on the boat, such as cruciform tail and dive brakes and ——— propellers, trying to cut down noise with high speeds and have a more efficient vehicle.

The way we can best defeat the Russian ASW effort is to make our submarine as quiet as possible, but also, Mr. Laird, we have to do a lot in the countermeasure business—decoys, evasion devices—and we have to do——

Mr. LAIRD. What are you doing in the way of decoys? That is the area that I am particularly interested in because it seems like an area that is not too expensive to pursue.

Admiral HAYWARD. In this particular budget——

Mr. LAIRD. It seems there is a reduction in that area in this budget.

Admiral HAYWARD. In decoys?

Mr. LAIRD. In noise reduction, as I recall it; offhand, there is a reduction from about nine-point-some million dollars to about $5 million.

Admiral HAYWARD. In this area; but in the time period of this budget we will have the *Thresher* coming out where we have put a lot of money in the noise reduction program.

Mr. LAIRD. What about decoys?

Admiral HAYWARD. I have a half million dollars actually in the $45 million add-on that we put in for decoys.

One thing in the ASW business concerning the Russians—if we can keep them from flying over all of the sea, which are friendly waters to us now, their ASW problem will be a great deal more difficult than ours.

Mr. LAIRD. When we were talking about the carrier the other day I asked about the possibilities of just towing behind a destroyer some sort of a noise producer which would be like a Victrola record to reproduce the sound of a submarine.

Admiral HAYWARD. This is a very good area.

Mr. LAIRD. What is being done there?

Admiral HAYWARD. Captain Fahy, from the Bureau of Ships, is the head of that research.

Mr. LAIRD. This might not be a good approach, but it seems to me it is reasonable in price. I wonder if it is right.

Captain FAHY. We have looked into this really hard without spending much money on it. Our laboratories do it and various other sources are looking at this decoy work.

If you are trying to simulate anything so large as a carrier, the amount of energy required to be put into the water to give you range of detection on the enemy's submarine gear is prohibitive.

On the other hand, if you can get something that you can leave near his sound gear, dropping from a plane or some other way, which starts up and indicates that you have something running away, this is feasible and we are looking at that program closely.

Mr. LAIRD. In this budget?

Captain FAHY. In this budget, sir.

Mr. FLOOD. Thank you very much, gentlemen. This is always a section which intrigues this committee, as you know.

By the length of the examination and the wide field we have covered, you can see this is an exciting and interesting section for this subcommittee all the time. It is unusually so this year.

THURSDAY, MARCH 17, 1960.

RESEARCH, DEVELOPMENT, TEST, AND EVALUATION, AIR FORCE

WITNESSES

HON. JOSEPH V. CHARYK, UNDER SECRETARY OF THE AIR FORCE
LT. GEN. R. C. WILSON, DEPUTY CHIEF OF STAFF, DEVELOPMENT
HON. LYLE S. GARLOCK, ASSISTANT SECRETARY OF THE AIR FORCE (FINANCIAL MANAGEMENT)
MAJ. GEN. R. J. FRIEDMAN, DIRECTOR OF BUDGET, COMPTROLLER OF THE AIR FORCE
MAJ. GEN. B. J. WEBSTER, DIRECTOR OF PROGRAMS, DEPUTY CHIEF OF STAFF, PLANS AND PROGRAMS
MAJ. GEN. M. C. DEMLER, DIRECTOR OF RESEARCH AND DEVELOPMENT, DEPUTY CHIEF OF STAFF, DEVELOPMENT
COL. S. S. HUNN, CHIEF, PROGRAM FUNDING DIVISION, DIRECTORATE OF DEVELOPMENT PROGRAMING, DEPUTY CHIEF OF STAFF, DEVELOPMENT
LEWIS C. MEYER, CHIEF, RESEARCH, DEVELOPMENT, AND MISSILE DIVISION, DIRECTORATE OF BUDGET, COMPTROLLER
COL. H. L. EVANS, ASSISTANT DEPUTY COMMANDER, SPACE PROGRAMS, AIR FORCE BALLISTIC MISSILE DIVISION, AIR RESEARCH AND DEVELOPMENT COMMAND
CAPT. C. D. GRIBBLE, PROGRAM ANALYST, DIRECTORATE OF DEVELOPMENT PROGRAMING, DEPUTY CHIEF OF STAFF, DEVELOPMENT
LT. COL. MATTHEW C. HARRISON, ACTING SPECIAL ASSISTANT, ASSISTANT SECRETARY OF DEFENSE, COMPTROLLER

Program and financing

	1959 actual	1960 estimate	1961 estimate
Program by activities:			
Direct obligations:			
1. Military sciences	$135,193,731	$122,483,136	$116,817,111
2. Aircraft and related equipment	273,481,597	370,065,661	312,777,032
3. Missiles and related equipment	292,014,360	317,293,761	318,257,455
4. Military astronautics and related equipment	221,067,724	296,131,486	249,740,161
6. Ordnance, combat vehicles, and related equipment	7,774,063	13,980,800	13,092,277
7. Other equipment	175,086,260	302,183,714	229,414,964
8. Programwide management and support	117,595,923	104,536,091	97,401,000
Total direct obligations	1,222,213,658	1,526,674,649	1,337,500,000
Reimbursable obligations:			
1. Military sciences	35,825,635	39,402,892	40,000,000
2. Aircraft and related equipment	297,609	85,000	
6. Ordnance, combat vehicles, and related equipment	30,000		
7. Other equipment	16,094	30,000	
8. Programwide management and support	13,341,258	35,632,108	16,000,000
Total reimbursable obligations	49,510,596	75,150,000	56,000,000
Total obligations	1,271,724,254	1,601,824,649	1,393,500,000
Financing:			
Comparative transfers from (−) other accounts	−455,085,001	−158,348,158	
Unobligated balance brought forward	−72,672,149	−85,532,491	−164,231,000
Unobligated balance transferred to "Salaries and expenses, Advanced Research Projects Agency, Department of Defense" (72 Stat. 712)	170,000		
Unobligated balance transferred (73 Stat. 377) from—			
"Aircraft, missiles, and related procurement (Air Force)"		−11,875,000	
"Salaries and expenses, Advanced Research Projects Agency, Department of Defense"		−19,000,000	
Unobligated military assistance orders transferred to other service accounts	1		
Advances and reimbursements from—			
Other accounts	−47,061,641	−73,910,510	−54,900,000
Non-Federal sources	−2,448,955	−1,239,490	−1,100,000
Unobligated balance carried forward	85,532,491	164,231,000	160,731,000
New obligational authority	780,159,000	1,416,150,000	1,334,000,000
New obligational authority:			
Appropriation	751,829,000	1,159,900,000	1,334,000,000
Transferred from—			
"Emergency fund, Department of Defense" (72 Stat. 713)	41,030,000		
"Salaries and expenses, Advanced Research Projects Agency, Department of Defense" (73 Stat. 377)		256,250,000	
Transferred to "Research and development," National Aeronautics and Space Administration (72 Stat. 433)	−12,700,000		
Appropriation (adjusted)	780,159,000	1,416,150,000	1,334,000,000

Object classification

	1959 actual	1960 estimate	1961 estimate
AIR FORCE			
Total number of permanent positions	24,121	23,970	24,002
Full-time equivalent of all other positions	18	27	36
Average number of all employees	23,173	23,135	23,173
Number of employees at end of year	23,093	23,221	23,324
Average GS grade and salary	7.6 $6,395	7.7 $6,440	7.7 $6,490
Average salary of ungraded positions	$5,952	$5,981	$6,063
01 Personal service obligations:			
Permanent positions	$144,277,201	$144,742,133	$146,719,289
Positions other than permanent	152,862	235,400	289,660
Other personal services	3,832,115	4,520,837	4,091,566
Total personal service obligations	148,262,178	149,498,370	151,100,515
Direct obligations:			
01 Personal Services	147,855,944	149,088,645	150,687,190
02 Travel	8,992,000	9,013,000	7,422,000
03 Transportation of things	4,267,956	3,393,000	3,294,000
04 Communication services	2,320,000	3,075,000	2,696,000
05 Rents and utility services	13,590,000	18,378,000	18,999,000
06 Printing and reproduction	709,000	687,000	800,000
07 Other contractual services	694,560,072	994,315,445	860,898,945
Services performed by other agencies	41,513,000	21,500,000	18,200,000
08 Supplies and materials	77,174,915	57,293,101	48,444,325
09 Equipment	221,112,460	259,640,246	216,358,358
11 Grants, subsidies, and contributions	9,736,134	9,882,892	9,346,499
13 Refunds, awards, and indemnities	350,000	399,000	356,000
15 Taxes and assessments	59,429	59,607	56,584
Subtotal	1,222,240,910	1,526,724,336	1,337,558,901
Deduct quarters and subsistence charges	54,588	57,135	58,901
Total direct obligations	1,222,186,322	1,526,667,201	1,337,500,000
Reimbursable obligations:			
01 Personal services	406,234	409,725	413,325
02 Travel	204,000	121,000	131,000
03 Transportation of things	560,000	118,000	116,000
04 Communication services	991,000	1,158,000	1,200,000
05 Rents and utility services	1,413,000	1,606,000	1,668,000
06 Printing and reproduction	8,000	7,000	7,000
07 Other contractual services	40,681,596	62,578,892	43,154,000
08 Supplies and materials	4,742,766	7,830,275	7,974,675
09 Equipment	484,000	1,296,108	1,312,000
11 Grants, subsidies, and contributions	14,000	18,000	17,000
15 Taxes and assessments	6,000	7,000	7,000
Total reimbursable obligations	49,510,596	75,150,000	56,000,000
Total, Air Force	1,271,696,918	1,601,817,201	1,393,500,000
ALLOCATION ACCOUNTS			
Total number of permanent positions	3	----------	----------
Average number of all employees	3	----------	----------
Number of employees at end of year	0	----------	----------
01 Personal services: Permanent positions [1]	$23,689	----------	----------
02 Travel	692	----------	----------
04 Communication services	13	----------	----------
07 Other contractual services	1,412	$7,448	----------
11 Grants, subsidies, and contributions	1,530	----------	----------
Total, allocation accounts	27,336	7,448	----------
Total obligations	1,271,724,254	1,601,824,649	1,393,500,000
Obligations are distributed as follows:			
Air Force	1,271,696,918	1,601,817,201	1,393,500,000
Department of Commerce	811	7,448	----------
Library of Congress	531	----------	----------
Federal Aviation Agency	25,994	----------	----------

[1] Portion of salaries covered in schedules to be submitted by the Federal Aviation Agency.

Summary of requirements by budget program

Title	1959 actual	1960 estimate	1961 estimate
Military sciences	$170,137,808	$150,669,000	$153,757,000
Aircraft and related equipment	355,854,700	321,215,000	335,382,000
Missiles and related equipment	313,506,538	354,425,000	349,504,000
Military astronautics and related equipment	264,131,000	278,879,000	261,846,000
Ordnance, combat vehicles and related equipment	9,092,026	12,704,000	10,141,000
Other equipment	200,408,773	274,014,000	241,459,000
Programwide management and support	99,431,735	108,438,793	96,911,000
Total program requirements	1,412,562,580	1,500,344,793	1,449,000,000
Less portion of program to be obligated in subsequent fiscal years	−177,585,587	−104,231,000	−160,731,000
Plus obligations incurred against prior year program funds	36,747,261	205,710,856	105,231,000
Total obligations	1,271,724,254	1,601,824,649	1,393,500,000

Correlation of program requirements with appropriation or estimate

(1)	Fiscal year 1959 actual (2)	Fiscal year 1960 estimate (3)	Fiscal year 1961 estimate (4)
Program requirements	$1,412,562,580	$1,500,344,793	$1,449,000,000
Reimbursements	−49,078,097	−75,150,000	−56,000,000
Comparative transfers between appropriations	−594,448,159	0	0
Actual transfers between appropriations	−28,330,000	−287,125,000	0
Adjustments between program years	+11,122,676	+21,830,207	−59,000,000
Appropriation or estimate	751,829,000	1,159,900,000	1,334,000,000

Mr. MAHON. We will now begin our hearing on the research, development, test, and evaluation requirements of the Air Force for the fiscal year 1961.

I might say to you, gentlemen, that we have had hearings on the R.D.T. & E. budgets of the Army and the Navy. In the beginning of each one of these hearings I have made a number of observations with regard to research and development. For example, one of the previous services told about its need for certain high priority research and development that the service would like to have had and which was not included in the budget.

DENTAL RESEARCH

I interposed a question of why they included such things as research and development funds for dental care and things of that kind in their program if they were so concerned about other things which were so urgent and which had to do specifically with the very survival of the Nation and not cavities in people's teeth.

We have dozens of dental schools. We have the Public Health Service which has a large program in study and research in the field of dentistry. It did not make much sense to me that each service has to be in this field. I am sure the Air Force is in the same field.

Do you know, Mr. Secretary?

Mr. CHARYK. I am sure they are. I do not believe this type of work is included in our research program, however.

Mr. MAHON. I am not sure. I wish you would check it.

Mr. CHARYK. I can find out about it.

Mr. MAHON. Make an insert at this point in the record.

(The information requested follows:)

The Air Force research program in dentistry in fiscal year 1961 is comprised of four projects amounting to $60,000 and encompasses a wide field of essential dental research concurrent with ever increasing flights above the earth and in space.

The major essential project included in this program and amounting to $30,000, is to determine whether dental filling materials are adversely affected by rapid changes in altitude, temperature, and other flight stresses.

RESEARCH ON AUTO ACCIDENTS

Mr. MAHON. I recall that one of the services had a research and development program on automobile accidents. Inquiry was made by this committee as to why this kind of program was in progress. It was said that so many of the people in the Armed Forces were getting hurt in automobile accidents they felt some study in this line would be good for the service. I believe it was the Air Force which said that, was it not?

General WEBSTER. I believe it was, 3 years ago.

Mr. MAHON. To me it was an absurdity.

Of course, I wish somebody could prevent slaughter on the highways, but it occurred to me it was not as highly urgent for the Department of Defense to pursue this area as areas such as defense against the intercontinental ballistic missile and antisubmarine warfare.

NEED TO SCREEN PROGRAMS

I hope, Mr. Secretary, we can screen these programs, and you probably have hundreds of them, so you do not do a lot of ridiculous things, perhaps just to give somebody a pat on the back or compliment him with a few taxpayers' dollars for his shop because others are getting money in their shop. I don't know what the story is and I will ask about some of those matters later.

I wanted more or less to present the same picture to you that I presented to the Army and the Navy.

Do you have any comment to make, General Wilson?

General WILSON. Not on this, sir. But I must agree we must screen our programs not to do ridiculous things. I would agree wholeheartedly with your comments, sir.

Mr. CHARYK. I certainly would agree. Actually during the past year we have set up a screening process for all of our applied research programs. We have looked at many of these on an individual basis. I am sure we do not have all of them reviewed as carefully as they might be, but I think we have taken a good step in the right direction.

Mr. MAHON. Do you have a statement, Mr. Secretary?

Mr. CHARYK. Yes, sir.

Mr. MAHON. General Wilson, do you have a statement?

General WILSON. Yes, sir.

Mr. MAHON. I suggest you proceed without interruption with your statements.

GENERAL STATEMENT OF UNDER SECRETARY OF THE AIR FORCE

Mr. CHARYK. Mr. Chairman and members of the committee, I am pleased to appear before your committee again and to participate in

the presentation of information concerning the fiscal year 1961 research, development, test, and evaluation budget for the Department of the Air Force. In my previous capacity as Assistant Secretary of the Air Force for Research and Development, I was, of course, directly concerned with the development of this budget which has been submitted for your consideration. Lieutenant General Wilson, the Deputy Chief of Staff, Development, will discuss in some detail the various elements of the proposed program for fiscal year 1961. I would, however, like to take a few minutes to discuss briefly the general philosophy underlying our approach to the research and development field, to highlight some of the key items in the program and to indicate the problem areas we see.

NEED FOR BASIC RESEARCH

Basically, the research and development effort itself can be categorized in four parts; namely, basic research, applied research, advanced development, and weapon system development. Public visibility is focused on the latter area and our military strength in the immediate future rests, of course, on such weapon system developments. However, our long-range military posture and national strength rest on the adequacy and vigor of the first area. Unfortunately, there is considerable public apathy and a lack of understanding in regard to this area. One of our most important responsibilities in the management of research and development, therefore, is the determination of the proper balance between these areas and the insurance that the program scope and content is adequate within each area. On the one hand, we must insure the continued adequacy of our military strength in the year immediately following, but in so doing it is essential that we do not neglect those items that could make the difference insofar as national survival is concerned in the longer range future. The foundation of our technical progress rests on the vigor of our basic scientific programs and their nature is such that if these are neglected no amount of dollars in later years can adequately eliminate the deficiencies that can be created. We have had, in my opinion, too many examples of such false economy in the past and I think that it is incumbent to our future security that they not be repeated. It is worthwhile to note that the Soviets have placed high emphasis on the support of the basic sciences and I believe that many of their recent advances and accomplishments reflect the soundness of this policy. This year about 20 percent of our "Research, development, test, and evaluation" appropriation is devoted to the support of basic and applied research, and it is our policy to eliminate harmful year to year fluctuations.

SELECTION OF PROJECTS FOR ADVANCED DEVELOPMENT

The concepts and knowledge which emerge from our research efforts are the basis, of course, for advanced developments which can in turn provide the background for future military weapon systems. As we move along this path, the cost of each individual undertaking increases rapidly and, correspondingly, the number of activities that can be undertaken becomes fewer and fewer. Keen judgment is therefore required to insure that our major resources and efforts are ex-

pended on those systems that can have the greatest impact on our military strength and military posture. I would like to dwell briefly on a point which I feel to be of great importance in the understanding and appreciation of our various research and development and weapon system programs. The development of a complete operational weapon system involves many factors beyond the normal development problems. These are costly and demand time for their successful accomplishment. They include such things as operational and training facilities, ground support equipment construction, spare parts, and so forth. These tasks very frequently overshadow in cost and time the actual development efforts on the weapon proper. Some or all of these operational aspects must be pursued as the development program proceeds if we are to expect operational deployment at the earliest date. Such a procedure, however, obviously involves major risks and uncertainties. Technical deficiencies and obstacles can and probably will arise and these will have a significant impact on the operational date and the program costs. In each case, therefore, a keen sense of judgment is required to balance the importance of the job, the technical risks involved, and the associated costs. A maximum risk program; that is, a complete application of the so-called concurrency principle, in all cases would be prohibitively expensive, wasteful, and inefficient; the economics in dollars and in technical manpower utilization, in turn, would limit the number of developments that could be undertaken. A minimal risk program, on the other hand, which would delay all operational aspects until the technical system was completely demonstrated would result in unacceptably late operational dates and limited military utility. In each case, therefore, we must endeavor to balance all of these factors and to arrive at an optimum solution in consonance with the military threat, the military potential, the military function to be performed, and the demands of other phases of our total military program.

ICBM PROGRAMS

We are today at a transition point in military weapon system development. Today our strategic capability rests almost completely on the manned bomber and our major defense problem is that associated with the countering of this type of threat. But, very quickly, the nature of the problem is changing to one where the missile will become the major element in our strategic striking forces and warning and possible defense against such attack become the major concerns of our defense forces. For reasons that have been detailed at great length, a full-fledged intercontinental ballistic missile development program was not initiated until 1954, and I believe that our country can be justifiably proud of the tremendous accomplishments that have been achieved in the brief span of time since that date.

It will be recalled that in that year a group of the most distinguished scientists and engineers in this country recommended the initiation of a major effort and estimated the capabilities that could be achieved and the results that could be expected over a 5- to 8-year span. The results that have been achieved have in practically all cases exceeded the optimistic expectations of this committee. I believe that a few of the statistics might be of direct interest at this

point. Five years ago it was recognized that the reentry problem was a tremendously difficult one. Some even felt that an adequate solution in a reasonable time period was out of the question. Our operational missiles will carry warheads having a ballistic coefficient 10 times lower than the first limiting values and will impact at very high speeds. Another example might be cited. It was estimated that a C.E.P. of 5 nautical miles might be achieved. Our recent series of successful ATLAS launches have been impacting within 2 nautical miles of the predesignated target.

The achievement of a sound structural design with a total weight to empty weight ratio of the order of 0.9 was also considered by many to be well beyond the state of the art in the time period available. The best estimates here again have been exceeded. In none of our missile programs have really major technical barriers been encountered. All, however, have had their share of the kind of technical difficulties that are minor in nature, frequently difficult to diagnose, but spectacular in failure, and as these have been removed by careful testing and data analysis, the missiles have finally performed beyond original expectation. It should be recalled, for example, that as recently as last August, five successive ATLAS failures led many to publicly question the soundness of the missile and its operational suitability, and there were many who suggested that our emphasis should be placed on other missiles such as TITAN, MINUTEMAN, and POLARIS. More recently, the TITAN encountered its share of difficulties but these in turn appear to have been overcome and the missile has demonstrated the soundness of its design by performing perfectly in all respects over an intercontinental range.

COMMITTEE SUPPORT OF ATLAS PROGRAM

Mr. MAHON. I think it would not be inappropriate at this point to inject a brief statement.

Dr. York was quoted some time ago with respect to the unhappiness of many people with the poor performance at a certain period last year of the ATLAS. The impression was left somewhat that perhaps this committee wanted to forsake the ATLAS and go to the TITAN.

We discussed that with Dr. York and clarified the record completely insofar as I know.

I think everyone here knows that this committee at no time advocated that the ATLAS be thrown overboard and that we should place all our energy on the TITAN.

Mr. CHARYK. That is right.

Mr. MAHON. The truth is that even during this stage of disappointing results, we brought out our report on the defense bill last year and recommended an acceleration of the ATLAS program by about eight squadrons.

Mr. CHARYK. I am aware of that, Mr. Chairman. I think it is also true that there were other elements, however, who felt that serious consideration should be given to the possible reorientation of our missile program.

Mr. MAHON. I am sure that in the Pentagon and out, and within industry, there were various views, and perhaps in Congress there were varied views.

Dr. York, I think, clarified that situation.

Mr. CHARYK. I think the record with respect to this committee's position is very clear.

General FRIEDMAN. I think, Mr. Chairman, it is especially significant that this committee appropriated additional moneys at that time to accelerate the ATLAS missile and this certainly should, of itself, make the record clear as to where the committee stood.

Mr. MAHON. Please proceed.

SUCCESSES IN BALLISTIC MISSILE PROGRAM

Mr. CHARYK. It is interesting to note that in the case of THOR the first long-range flight with closed loop guidance occurred on the 10th flight and approximately a year after the first flight attempt. In only 3 of these first 10 attempts were all test objectives achieved. A year later the first military demonstration of the THOR missile was achieved and the long string of THOR successes is well known. In the case of ATLAS, a more complicated system than THOR, it required approximately a year and a half, and 15 flight attempts, to reach the first intercontinental range closed loop guidance flight. But again, approximately a year later we achieved the first military demonstration of ATLAS capability. In only 7 of these 15 flights were the large majority of test objectives achieved. In the case of TITAN, intercontinental range with closed loop guidance was achieved a year after the first flight. As anticipated an intensive ground testing program and the value of the ATLAS and THOR experience have permitted a streamlining of the flight test requirements to achieve specific objectives. In the case of TITAN, 9 flights were required to reach this point and of these, major test objectives were realized completely in 6 cases, representing the best success ratio to date. These recent tests give high confidence that an operational date in mid-1961 is certainly achievable. MINUTEMAN is, of course, in a much earlier stage of development, but we are confident that the experience gained in our other programs and the full application of the maximum ground test philosophy provide a basis for confidence in the achievement of the scheduled goals.

SPACE PROGRAMS

An important element in our research and development program is the series of efforts designed to exploit the military potential of the space medium which has been brought within our capability through the development of rockets and missiles. We view our responsibilities to be the full exploitation of technology for the development of systems to enhance our military capability and strength. We do not view space to be a separate medium but rather an extension of our previous horizons as a result of expanding technology. It is our responsibility to exploit to the fullest whatever medium will permit better, more effective, more economical or unique methods for carrying out military functions. In our assessment of the types of activities that should be pursued we must compare and evaluate other means for accomplishing the same ends. We do not feel that it is our function to explore and exploit the space medium for its own sake. Rather, it is our responsibility to utilize to the fullest whatever means are best for the fulfillment of our defense responsibilities. The DISCOVERER, MIDAS and SAMOS programs are aimed at the ex-

ploitation of the early warning and reconnaissance capabilities that are so vital in the ballistic missile age. The knowledge and experience gained from the ballistic missile efforts have, of course, been directly applicable in military space applications. We are, of course, still at an extremely early stage in our utilization of the space medium for the conduct of military tasks. Effective military use of the space medium involves several new elements which are basic to the determination of the importance and value of space systems. The prime elements are reliability and cost per pound in orbit. For most systems to be militarily and economically effective, reasonably long payload lifetimes in orbit must be achieved. This is a major task when one recognizes that military useful payloads will by nature be rather complex. Our goal is at present the achievement of payload lifetimes of the order of a year. To accomplish this end, improvements in reliability of at least an order of magnitude beyond our normal experience is required. In respect to costs, we must move in the direction of reducing the cost per pound in orbit in order to achieve military space systems that will be militarily and economically effective. Recently our first attempt to launch a prototype MIDAS payload into orbit was unsuccessful. It is perhaps worthy of note, however, that this first prototype of a military space system is a major step in size and complexity beyond our previous space efforts. The total useful payload that has been placed in orbit by the United States to date is only of the order of 2,200 pounds, of which approximately 2,000 pounds is attributable to the Air Force. A single MIDAS payload is of the order of 1,000 pounds and the total weight in orbit in the case of MIDAS is of the order of 3,000 pounds, although the first vehicles at lower altitudes will weigh of the order of 5,000 pounds. This represents a significant portion of the total poundage of about 19,000 pounds that has been placed in orbit by the United States to date. This enhanced capability is of course due to the development of appropriate upper stages for our ballistic missiles. This capability will be further enhanced with the advent of the AGENA B and next year the CENTAUR.

MANAGEMENT

I would now like to turn from a discussion of some of the technical highlights in our program to the important question of management of our research and development efforts. During the past year a major reorganization of the Air Research and Development Command has been implemented. The Command, under the direction of General Schriever, has been divided into four major functional divisions. These are the Ballistic Missile Development Division in Inglewood, Calif.; the Wright Air Development Division in Dayton, Ohio; the Command and Control Development Division in Bedford, Mass., and the Research Division, with headquarters in Washington, D.C. Each of these divisions has complete responsibility for all of the activities which fall within its area of cognizance regardless of where the contributing sources may be located geographically. For example, the rocket propulsion activities at Edwards Air Force Base are under the Ballistic Missile Development Division, and the Aeronautical Research Laboratory at Dayton, Ohio, comes under the Research Division. The total reorganization plan is in the process of

implementation. We are confident that it will play a major role in improving our management of the Air Force research and development program.

RELATIONSHIPS WITH OTHER ORGANIZATIONS

A final item which I believe to be of considerable significance in increasing the effectiveness of the conduct of research and development in the Department of Defense has been the establishment of close working relationships between the offices of the Director of Defense Research and Engineering, the Assistant Secretary of the Navy for Research and Development, the Assistant Secretary of the Air Force, Research and Development, and the Director of Research and Development of the Department of the Army. These working relationships have permitted a direct attack on many of the problems which interact across service boundaries, and I believe that the interrelationships which have been established will play a major role in the effective execution of the important research and development responsibilities of the Department of Defense.

Mr. MAHON. Thank you very much, Mr. Secretary, for your statement.

We will now proceed with the statement by General Wilson.

STATEMENT OF DEPUTY CHIEF OF STAFF, DEVELOPMENT HEADQUARTERS, U.S. AIR FORCE

Brief biographical sketch.—General Wilson was born in Centralia, Pa, July 11, 1905. He was commissioned from the U.S. Military Academy in 1928, and was graduated from the Flying School at Kelly Field in 1929. He is a graduate of the Air Corps Engineering School and the Air Corps Tactical School. During his career General Wilson has been closely associated with research and development. Highlights of his service include assignments to the Manhattan District; Deputy Chief for Air of the Armed Forces Special Weapons Project; Assistant Deputy Air Chief of Staff, Operations, for Atomic Energy; Commandant of the Air War College; Commander of the Third Air Force in the United Kingdom; Member of the Weapons Systems Evaluating Group; and wartime experience as the Chief of Staff of the 316th Bomb Wing, Okinawa. General Wilson has been awarded the Legion of Merit with two Oak Leaf Clusters.

General WILSON. Mr. Chairman and members of the committee, it is a pleasure to again appear before this committee to acquaint you with our research and development program for fiscal year 1961.

Before we get into the details, a few words concerning some of the factors that influence its formulation may be helpful in understanding the program.

As you know, the development of a major system is a time-consuming process, in fact, it requires from 3 to 8 years, depending upon the type of system being developed and the complexity of its equipment.

The costs of these programs also vary as the stage of development progresses. Initial phases are relatively cheap but costs increase rapidly and stay at a high level until well into the production cycle. The combination of long development periods and high costs make it imperative that we be highly selective in initiating programs for new systems.

We start a system development for two reasons. First, to provide a needed weapon for introduction into the inventory and second, to develop a system incorporating advances that are beyond the exist-

ing technology but which, if achieved, will have a high probability of being produced for the operating commands. Because both of these have high dollar implications, great selectivity is used in starting system developments.

The combination of all these factors determines, to a large extent, the number of weapon systems under development at any one time. This is particularly true this year. You will notice, as the details of the program are discussed, that the weapon systems included this year are those which were started in prior years by the Air Force, or in the case of some of the space projects, the Advanced Research Projects Agency.

As we have stated in past years, our objective is to have a dynamic and effective research and development program that will maintain our technical superiority. Although we are not introducing new weapon systems this year, our goal has not changed. The research and development program to be supported with the request for $1,334 million that I am presenting today has been formulated with that objective as the focal point. While all developments are so oriented, the objective will best be achieved through our more forward looking programs—specifically, the advanced developments, applied, and basic research, as Dr. Charyk has emphasized. These are the areas in which we are probing the unknown and success will give us the means of building better weapon systems for the future.

CHANGES IN RESEARCH AND DEVELOPMENT PROGRAM

During the past year, we have reorganized the structure by which we manage the research and development program and have created a new area entitled "Advanced Developments." These are items that lie somewhere between the effort that is carried on in the research program and the development of complete systems for inclusion in the operational inventory. The purpose and the exact nature of the items included in this area will become apparent when I discuss the projects that we have identified as advanced developments.

Also, the scope of the "Research, development, test, and evaluation" appropriation has been enlarged. Last year we reported that some $410 million of research and development support had been moved from other appropriations, the object being to identify all research and development not oriented to inventory use, within one funding area. We are continuing this transfer in fiscal year 1961 with the movement of another $339 million which includes $256 million identified with aerospace systems. The transfer this year does not completely transfer all research and development funds to research, development, test, and evaluation. There still remains $1,095 million of research and development support in the "Procurement" appropriations (chart 1), as indicated on this chart. (The charts referred to in this statement will be found at the conclusion of the statement.) Although the ballistic missiles receive larger dollar support, the B–70 is the only advanced system being fully funded from the "Procurement" appropriation.

RESEARCH AND DEVELOPMENT PROGRAM

This next chart (chart 2) shows a comparison of the total research, development, test, and evaluation funds available for research and

development in fiscal year 1961 to the funds provided in fiscal years 1959 and 1960.

Although the total program amounts to $1,393 million, the new obligating authority requested is $1,334 million. The $59 million difference is to be made available from fiscal year 1960 research and development funds already appropriated.

This next chart (chart 3) shows the fund distribution by the four major program areas for fiscal years 1959, 1960, and 1961. It is apparent from the figures that the program has remained relatively constant not only in total funds but you will notice that we have attempted to maintain a stable program in each major area thus avoiding discontinuities.

As a last summary chart (chart 4) (classified chart, not in record) before I discuss the individual items contained in the program, I have related the fund distribution by management structure to the budget structure in order that a correlation to the justification book may be maintained.

With this overall view as background, I will proceed to the discussion of the individual elements of the program. As in past years, I will use the management structure, that I mentioned earlier, as a basis for its explanation.

The first major area, the operational development program (chart 5), has been subdivided into the classical mission areas. The strategic air defense, and tactical areas need no definition. However, a word about the control and support area may be helpful. The projects that appear in this area are primarily electronic control systems that are needed to exploit fully the combat capability of the aircraft and missiles now in our inventory or under development. Their role is to help us control the active weapons and use them to a much more effective degree. A typical example is the SAGE subsystem that is an integrated and essential part of our continental air defense system.

A total of $214 million is requested for strategic systems (chart 6). This amount is much larger than that requested for any of the other mission areas because of the effort being placed on the SAMOS program; $200 million are required for this project. The SAMOS reconnaissance system concept utilizes a satellite vehicle, modified ICBM booster, launch facilities, tracking facilities, and a complex communication and data processing network. The objective is to place a vehicle in a 94-minute polar orbit which will enable the system to view the entire surface of the earth.

Some $12 million are planned for the ATLAS-TITAN-MINUTEMAN systems; the bulk of the moneys is programed for reentry vehicle studies, penetration aids, noncryogenic fuels and silo-type launcher studies.

About $2 million will be spent on planning and studies of advanced strategic systems.

In the second area, air defense (chart 7), $41 million of the $43 million programed are planned for MIDAS. This is a complementary system to the existing ballistic missile early warning system better known as BMEWS and will contain a network of satellites placed on polar orbit. Each vehicle will be capable of detecting ballistic missiles during their launch phase and relay this information to the BMEWS system. Test launches of MIDAS vehicles will

be made at its operational altitude to evaluate its capability to detect ICBM's above the earth's atmosphere.

Six hundred thousand dollars are for completion of the test work on BOMARC.

Some $1.5 million are planned for studies on aero space systems, electromagnetic radiation weapon systems, and advanced defense concepts.

As you can see (chart 8), from the amount planned in tactical systems, the Air Force does not have an extensive program in this area. BULLPUP, an adaptation of a Navy developed air-to-surface missile, with $5 million planned, is the only significant project under development this year for inclusion in the inventory. Funds will be used to continue work on the airframe and guidance system. This system has a highly accurate guidance system and an all weather capability. It will be used with the F–100 or similar type aircraft.

About $1.5 million are planned for tactical system studies.

The dispersed site tactical fighter will be discussed later with advanced systems.

As mentioned earlier (chart 9), the control and support systems are primarily electronic, the only exception being the powered target support system. I will briefly relate our objectives for 1961.

The Air Force communication system encompasses all means of communications: radio, microwave, teletype, and telephone. The major portion of the fiscal year 1961 funds will be used for designing a communication system. This will include the systems engineering necessary to integrate the many equipments needed to satisfy the severe demands envisioned during the 1965–70 time period.

The intelligence data handling system is an integrated system for collecting, processing, analyzing, storing, and disseminating intelligence information. We will use the fiscal year 1961 funds to complete the Intelligence Center and start testing of those equipments as an integrated unit. In addition, we will complete the engineering design and fabrication of equipments for the Headquarters Air Force Intelligence Center.

The Strategic Air Command Control System will provide the commander-in-chief, Strategic Air Command, with up-to-the-minute information on the disposition and status of his forces. During fiscal year 1961, the elements of the experimental system at Paramus, N.J., will be installed and complete system testing and evaluation will be initiated.

In addition, we have several other systems funded at much lower levels. Of these, the weather observation and forecasting system and powered target systems are joint programs with other Government agencies.

OPERATIONAL SUPPORT

The operational support items (chart 10) are not weapons of combat, but are essential to the support of the combat systems. Neither are they peculiar to any one weapon and are, therefore, not developed in conjunction with a particular system. To insure that none of these important items is overlooked, we have classified the 200 or more items being developed into seven general areas. An understanding of the type of items and their importance can be gained by examining a few typical developments.

In 1961 we will develop an infrared warning receiver to be used by the Strategic and Tactical Air Commands to detect increases in infrared sources in sufficient time to permit necessary and adequate countermeasures. A long-range (1,500-mile) electronic geodetic survey system will be developed to measure azimuth within a few hundred feet at the maximum range; current equipment is limited to a range of about 250 miles. This equipment will give us an improved capability to do aerial mapping and charting. Other developments are continuing in the area of countermeasures aircraft arresting barriers and reconnaissance equipment.

ADVANCED DEVELOPMENT PROGRAM

As explained earlier, we have grouped certain developments and efforts, previously started, into a new area entitled "Advanced developments." This next chart, with prior year funds on a comparable basis (chart 11), shows the distribution of funds by the major subdivisions. Your attention is invited to the amount of money that we are spending on developments that are more advanced technically than those in the operational program. Admittedly, there is a certain amount of risk because of the many unknowns, but to maintain our leadership in the scientific world, we must push to the very limit of the technical capability of the military-industrial-scientific team.

Two hundred and thirty-five million dollars of the three hundred and fifty-five million dollars in this program are earmarked for advanced systems (chart 12). Undoubtedly, you have followed the progress of the X–15 research vehicle. The $6 million planned for this year will provide for the flight test program and will cover completion of development, fabrication, and test of the propulsion system.

Another project, the Dispersed Site Tactical Fighter, is a short-field landing and take-off airplane that can be used for close support of combat troops. $31 million are programed in this area for continued development of this airplane which can operate from forward areas without an airbase complement as we know it. Feasibility studies are underway by manufacturers who are interested in building this vehicle.

$50 million are planned for DYNASOAR to continue design and fabrication of the airframe, airborne subsystems, ground support and checkout systems to give us the ability to place a man in a suborbital controlled vehicle. Recently, contracts were awarded to the principal contractor for work on the vehicle itself. A contract will be awarded in the very near future to an associate contractor to intensify engineering efforts on the booster portion of DYNASOAR. We propose detailed and intensive tests of materials, structural shapes, and wind tunnel models during the fiscal year.

$5 million are programed for the anti-intercontinental ballistic missile program. This system will give us a more advanced capability to detect and track ballistic missiles leading to a kill capacity. The fiscal year 1961 funds will be used to continue an active applied research program aimed at achieving the system objective. The program was identified last year as the Ballistic Missile Defense System.

Next, we show $75 million for aircraft nuclear propulsion development. These funds include an appropriate expansion of the indirect cycle program to accelerate the development and testing of a high-

power reactor propulsion system, and the continued development of the X–211 direct cycle engine. Associated studies on an airframe and work on engine and reactor compatibility, radiation effects, and safety analyses are also planned in fiscal year 1961.

$50 million are programed for the continuation of the development of the GAM–87, SKYBOLT. This missile is to be carried by our strategic bombers and can be released at a range of up to 1,000 miles from the target thus greatly increasing the flexibility and effectiveness of our bomber force. The fiscal year 1961 funds will be used to design, develop and test the airframe. Work on the ground support equipment, guidance, propulsion and other subsystems will be started.

We have planned approximately $15 million for DISCOVERER. The primary objectives of the DISCOVERER program, a research system to support SAMOS and MIDAS, will be to demonstrate orbital capability and to obtain biomedical and advanced engineering test data from the recoverable payload capsules.

Three other projects funded at a much lower level are to be continued.

$14 million are planned for test instrumentation (chart 13). In this area, we develop the special instrumentation and techniques which are required to perform research and development tests. The major portion of these funds are planned for modernization of the instrumentation at the Atlantic Missile Range which is used by all services. Development effort will be continued on instrumentation of the Holloman track for tests of missile inertial guidance systems and advanced telemetry instruments.

In the subsystems and components area, the Air Force is currently pursuing a joint program with the Atomic Energy Commission. This is the nuclear ramjet engine, better known as PLUTO. For the $7 million planned for this project, extensive testing of the TORY II reactor will be conducted, breadboard versions of ground and flight-type engine controls will be fabricated and tested, and detailed design of a flight-type engine will be completed.

(Chart 14.) In the next area, $99 million are planned for development support. For the first time this year, we have grouped Rand, Lincoln Laboratories, Mitre, Space Technology Laboratories, and Anser in this area.

$13.5 million are planned for Rand to continue its program of scientific study and research on the broad subject of air warfare.

There are $21 million programed for Lincoln Laboratories to cover its efforts in general research toward discovering new technical concepts which are applicable to national defense. Work will be conducted in areas of solid state, information processing, communications, radar and systems research.

The Mitre Corp., a subsidiary of the Massachusetts Institute of Technology, has been engaged to aid the Air Force in the solution of the complex problem related to the electronic area. The $20 million programed will cover the cost of the Mitre contract. In addition to the operation of the experimental SAGE sector, Mitre will provide engineering support and technical advice in the effort to integrate the air defense weapons and the associated ground environment.

Also, $44 million are planned for the Space Technology Laboratories. The bulk of this money will be used to pay the salaries of the

scientists and engineers engaged by the Air Force to assist in the ballistic missile program. STL has been given the responsibility for the systems engineering associated with the ballistic missiles. They evaluate contractor proposals to insure that they are technically sound. They act as project managers to make sure that all the subsystems are compatible and will work together as a whole. They provide technical direction to the whole ballistic missile program until it is turned over to the operating command. While the greatest portion of the actual development is done by the missile contractors, STL does a small amount of applied research work aimed at general improvement of the program.

One million dollars are programed for Anser, Analytic Services, Inc. This is a study group operating directly in support of Headquarters, U.S. Air Force for the purpose of assisting in the quick evaluation of development planning problems.

THE RESEARCH PROGRAM

The research program (chart No. 15), with two major subdivisions represents the future potential of the Air Force to maintain its supremacy in the technically expanding world. A relatively constant level of effort must be maintained in these areas if a steady flow of knowledge is to be expected. As you can see from the chart, we have tried to maintain this continuity. Using the best corporate judgment of the Air Force, industry and the scientific community, a constant review is made to insure that the program is dynamic and forward looking.

Our applied research effort is categorized into many areas of interest. These range from investigations of new types of materials to determinations of the human factors involved in future weapon systems. I would like to give you a few examples of the type of work that is being done.

Military and civilian agencies have long been concerned with the lack of metallic materials that can withstand extremely high temperatures. Our portion of this coordinated program has been directed largely toward the refractory metals such as molybdenum, tungsten, niobium, and beryllium. These are of particular interest because of their strength at high temperatures. A recently developed molybdenum alloy retained its high strength properties at 1,800° F. for 100 hours. This was an initial step in the quest for a molybdenum alloy that will withstand temperatures in the 2,000° to 5,000° range. Further studies and investigations in this area will be continued.

Another area that will be investigated in fiscal year 1961 is improvement of the effectiveness of air-to-air missiles through the use of radically new configurations.

One of the major limitations on the useful lifetime of a reconnaissance satellite is the supply of photographic film that can be carried. We are investigating new materials and techniques that will replace the conventional photographic, silver bromide film. We are looking for a process that will not be affected by nuclear radiation; will be easily processed; have good sensitivity and resolution; and be reusable. During fiscal year 1961, we will continue investigating light sensitive dyes that have reversible properties; materials with photoelectron emission characteristics; and materials which de-

form when exposed to light. If successful, we will have a photographic process that will increase the usefulness of our reconnaissance satellites.

Flights for prolonged periods above the level of 80,000 feet will require a sealed environment to sustain life. Since we cannot carry all needed materials, we must duplicate the earth's environment in a small space and with a minimum weight. Our goal is a system which will independently perpetuate a breathable atmosphere; provide a source of food and water; reclaim wastes and harmful byproducts; and regulate temperature, pressure, and humidity. Two major approaches are to be continued in fiscal year 1961. First, work is continuing on the chemical regeneration process. Using this method, we hope to recycle all the waste products and produce oxygen and food. The other approach is to duplicate the normal biological process by including microscopic plants and one-cell animals in the sealed environment. These would absorb the waste gases and in turn give off oxygen. Algae is being explored as a food source as well as a regeneration agent. Success in manned space flight depends upon the success achieved in our efforts in this area. These are but a few examples of the variety of projects on which we are working.

As you know, applied research must be based on sound theories and ideas. To get this fundamental knowledge, we must rely on our basic research program (chart No. 16). Although thoughts cannot be rigidly channelized, we do establish areas of interest to the Air Force and direct our basic research effort along these lines. Our major areas of interest are indicated on the chart.

An example of recent achievement is the first working model of a magneto hydrodynamic generator. Thermal energy was converted into electrical energy by directing an ionized gas into an electromagnetic field and successfully harnessing the resultant current flow. A nuclear heat source to ionize the gas may make this a practical engine to supply small amounts of power and thrust over long time periods for use in space vehicles.

During World War II, a breakthrough into the 10,000-megacycle area made radar possible. We are now attempting to extend the useful electromagnetic frequency range into the infrared and optical regions. Prof. Charles H. Townes, of Columbia University, is responsible for an entirely new, practically noise-free amplifier-oscillator known as MASER. He is now extending the principles of MASER into the infrared and optical frequency region with Air Force support. This research shows great promise of success. It is expected to produce a major impact in many fields such as communications, detection, control, guidance, and related military and civilian uses where extreme sensitivity and high channel capacity are important. These are two projects being carried on in the basic research program to investigate ideas that may open up new avenues of weapon developments in future years. We have approximately 1,100 contracts covering work in the basic research area, all of them aimed at increasing knowledge in the area of Air Force interest.

COMMAND OPERATIONS

The last major area, command operations, contains those funds required for the operation and maintenance of all the laboratories, air-

fields, and test facilities of the Air Force research and development establishment as indicated on the chart (chart No. 17). Within this establishment, these funds pay for the administration of all our research and development contracts with industry; they pay for the "in-house" research performed; and for the engineering services required to keep our operating inventory modern and efficient. In fact, this program provides for all operating costs with the major exceptions of funds provided for central procurement, the military construction program, medical care, and the pay of military personnel which are all financed from other appropriations.

To give you a more specific understanding of the costs associated with this area, the $390.7 million requested are divided into four major categories (chart No. 18). The largest amount is for the pay of some 23,000 civilians necessary to help carry on the research and development performed by the Air Force. They aid in the administration of our technical contracts; they help manage the operation and they assist in the performance of the housekeeping duties necessary to the operation of our research and development establishment.

The funds necessary for the pay of the contractors who are operating certain of our major facilities rank next in order of magnitude; $126.3 million are required to pay for the operation of the Atlantic Missile Range, the Arnold Engineering Development Center, the Eglin Gulf Test Range, the Trinidad Radar, and several lesser sites. The major portion of these funds are used to pay the salaries of contractor-hired personnel.

The next item, supplies and equipment, includes local purchase, reimbursement to the Air Force stock fund for such expendables as fuels and lubricants, and procurement of nonstandard mission support equipment.

The last category consists of many and varied items. Specifically, such items as travel, communications, rents, utilities, printing, and contract maintenance of equipment and real estate are included.

This next chart (chart 19), shows this program for 3 fiscal years. This is the only major program area in the "Research, development, test, and evaluation" appropriation showing an increase over fiscal year 1960. Primarily, this increase is due to the fact that in fiscal year 1961 this appropriation will provide for support of the Headquarters, Air Research and Development Command, funded in past years from the "Operations and maintenance" appropriation. Although we have absorbed additional requirements of over $22 million, our total program is only $9.8 million greater than last year. Continued belt tightening and improvement in our management efforts will be emphasized to keep the operation costs proportional to the technical effort being supported.

SUMMARY

In conclusion, the program that I have presented today is different from previous programs by the addition of the large space projects. Just as we have progressed from manned weapons to missiles, we are now embarking on a new phase of effort that points the direction for the type of developments that will predominate in later years. The transition cannot be made abruptly; our program this year is continuing the development of those weapons that are ur-

gently needed in our inventory. Our advanced developments are bridging the gap between the weapons required now and those needed for aerospace operation. Our applied and basic research program is oriented to extend our knowledge into the fields most needed for the development of future weapons.

The distribution of funds reflects this transition and has been made in accordance with appropriate priority considerations. We are confident that this program strikes the proper balance, within the funds requested, between the known urgencies of today and the unknowns of tomorrow.

(The charts referred to follow:)

CHART 1.—*Fiscal year 1961 development, test, and evaluation support from procurement appropriations*

[In millions]

ATLAS	$228.3
TITAN	406.1
MINUTEMAN	287.0
B–70	75.0
HOUND DOG	10.6
BULLPUP	.2
BOMARC	19.5
MATS Modernization	50.0
Q–2C drone	.7
DYNASOAR	8.0
GAM–87 (Skybolt)	10.0
Total	1,095.4

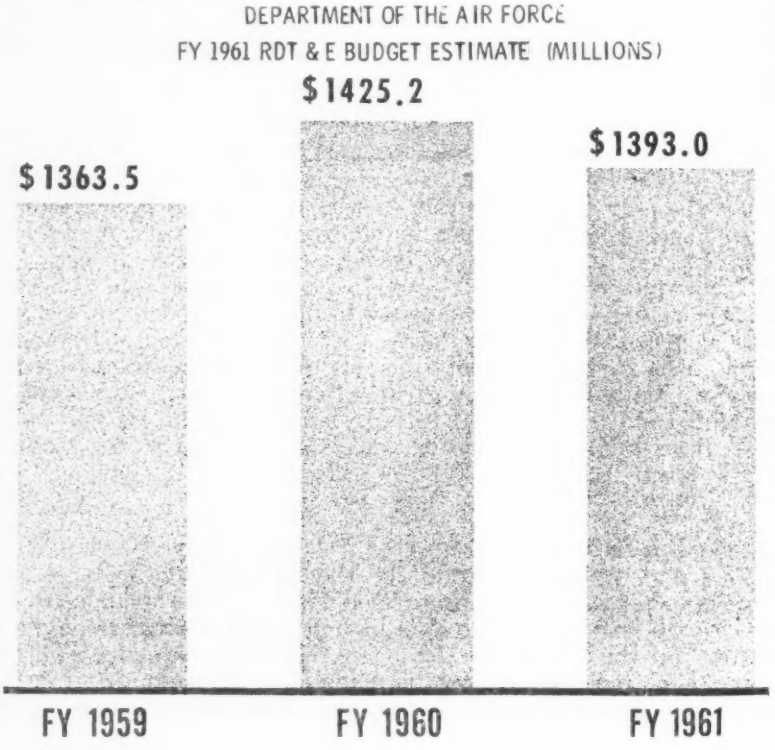


CHART 3.—*Fiscal year 1961 R.D.T. & E. budget estimate*

[In millions]

	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961
Operational development program	$375.3	$380.6	$367.3
Advanced development program	380.3	377.1	355.9
Research program	242.9	286.6	279.1
Command Operations program	365.0	380.9	390.7
Total	1,363.5	1,425.2	1,393.0

CHART 5.—*Fiscal year 1961 R.D.T. & E. budget estimate operational development program*

[In millions]

	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961
Strategic air warfare systems	$169.2	$183.3	$214.2
Air defense warfare systems	41.0	58.3	43.1
Tactical air warfare systems	7.2	5.6	6.5
Control and support systems	126.8	93.0	63.5
Operational support	31.1	40.4	40.0
Total operational development program	375.3	380.6	367.3

CHART 6.—*Fiscal year 1961 R.D.T. & E. budget estimate, strategic air warfare systems*

	Millions
SAMOS	$199.9
ATLAS	4.6
TITAN	3.3
MINUTEMAN	4.2
Studies	2.2
Total	214.2

CHART 7.—*Fiscal year 1961 R.D.T. & E. budget estimates, air defense warfare systems*

	Millions
MIDAS	$41.0
BOMARC	.6
Studies	1.5
Total	43.1

CHART 8.—*Fiscal year 1961 R.D.T. & E. budget estimate, tactical air warfare systems*

	Millions
BULLPUP	$5.0
Studies	1.5
Total	6.5

CHART 9.—*Fiscal year 1961 R.D.T. & E. budget estimate control and support systems*

	Millions
Air Force communications system	$14.0
Intelligence data handling system	9.7
SAC control system	16.7
Electromagnetic intelligence system	6.4
Weather observation and forecasting system	2.0
Powered targets	4.0
Space track	4.7
USAF Command control system	3.0
Studies	3.0
Total	63.5

CHART 10.—*Fiscal year 1961 R.D.T. & E. budget estimate operational support*

	Millions
Support equipment	$2.9
Guidance and weapons	14.0
Electronics and communications	13.6
Reconnaissance and intelligence	6.6
Aerospace environment	.2
Human factors	1.7
Targets and drones	1.0
Total	40.0

CHART 11.—*Fiscal year 1961 R.D.T. & E. budget estimate advanced development program*

[Millions]

	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961
Advanced systems	$296.5	$222.1	$235.5
Test instrumentation	9.3	14.7	14.0
Subsystems and components	4.1	7.0	7.0
Development support	70.4	102.0	99.4
Total advanced development program	380.3	377.1	355.9

CHART 12.—*Fiscal year 1961 R.D.T. & E. budget estimate, advanced development program*

Advanced systems:	*Millions*
X–15 research vehicle	$6.0
Dispersed site tactical fighter	31.0
Dynasoar	50.0
Anti-ICBM	5.0
Aircraft nuclear propulsion	75.0
GAM–87 (Skybolt)	50.0
Discoverer	15.1
Hyperenvironment test system	2.2
Avro vertical takeoff aircraft	1.0
Hiller tilt wing aircraft	.2
Total	235.5

CHART 13.—*Fiscal year 1961 R.D.T. & E. budget estimate, advance development program (continued)*

	Millions
Test instrumentation	$14.0
Subsystems and components: Propulsion (Pluto)	7.0

CHART 14.—*Fiscal year 1961 R.D.T. & E. budget estimate, advanced development program (continued)*

Development support:	*Millions*
Rand	$13.5
Lincoln Laboratory	21.0
Mitre	20.0
Space technology laboratory	43.9
Anser	1.0
Total	99.4

CHART 15.—*Fiscal year 1961 R.D.T. & E. budget estimate*

[In millions]

	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961
Research program:			
Applied research	$201.8	$248.7	$237.0
Basic research	41.1	37.9	42.1
Total research program	242.9	286.6	279.1

CHART 16.—*Fiscal year 1961 R.D.T. & E. budget estimate, research program*

Basic research:	*Millions*
Propulsion	$9.0
Materials	11.3
Electronics	7.7
Geophysics	3.8
Biosciences	2.7
Aeromechanics	7.6
Total	42.1

DEPARTMENT OF THE AIR FORCE

USAF R & D INSTALLATIONS

CHART 18.—*Fiscal year 1961 R.D.T. & E. budget estimate*

Command operations:	*Millions*
Civilian personnel	$150.7
Contractor-operated installations	126.3
Supplies and equipment	64.1
Other	49.6
Total	390.7

CHART 19.—*Fiscal year 1961 R.D.T. & E. budget estimate, compared operations*

	Millions
Fiscal year 1959	$365.0
Fiscal year 1960	380.9
Fiscal year 1961	390.7

CONVERSION OF HEAT DIRECTLY INTO ELECTRICITY

General WILSON. Mr. Chairman, that completes my statement.

With your permission, I would like to show you this little model which converts heat directly into electricity. Following that we have a short movie, if the committee would like to see it, on certain technical matters.

Mr. MAHON. All right.

Mr. FORD. Is that Dr. Partovitz' idea?

General WILSON. He has been engaged in this.

Mr. MAHON. Tell us what you are going to do over there, Captain.

General WILSON. This is the device, sir, that puts an ionized gas through a coil and thus creating a current which is made to flow directly to a little motor to turn a propeller.

Mr. MAHON. Is that alcohol burning?

Captain GRIBBLE. That is the propane tank, sir.

General WILSON. We find this curious because it is a direct conversion of heat into mechanical energy.

Mr. FLOOD. Still no use of coal.

Where is the ionization?

General WILSON. I believe that is produced by the heat.

Mr. MAHON. Where is it burning?

General WILSON. In that small jet on the right hand side.

Mr. FLOOD. The gas comes out of that tank into the tube. You ignite the tube. It is a very novel method of igniting gas.

General WILSON. Then it flows through the coil, produces a current which is used to run the motor.

Mr. FORD. Does this have potential to produce electricity for cities and communities.?

General WILSON. I doubt it. I think this would be rather inefficient for that purpose, but it is small and light and for very small amounts of energy could be useful in a satellite or something of that sort.

Mr. FLOOD. Is this part of your miniaturization program for space?

General WILSON. No. This is just a new application. This is just a gadget at the moment. If we can make something practical out of it this gives us a new approach for producing power.

Mr. FLOOD. This is not what you were talking about, is it, that was more important than automobiles?

Mr. MAHON. I do not think we care if people study what makes grass green, to a certain extent.

BASIC RESEARCH PROGRAM LEVEL

On page 1 of your statement near the bottom of the page, Mr. Secretary, you said, "Basically the R. & D. effort itself can be categorized in four parts; namely, basic, applied, advanced, and weapons system development."

Public visibility is focused on the latter two.

You say, "Unfortunately, there is considerable public apathy and a lack of understanding in regard to the area of basic research."

Do you think there is coming about in this country an increased understanding and interest by the public generally in basic research?

Mr. CHARYK. I think the situation has improved considerably in recent years in this regard.

Mr. MAHON. It has been said that probably 10 percent of the resources of a company profitably should be devoted to basic research. That is a figure that has been tossed around. I am not quite familiar with the origin. I believe about 3 percent of your program is basic research.

Mr. CHARYK. Well, actually to the figure that is specifically labeled "basic research" in the budget submission, we should add the inhouse research work that is conducted within the various laboratories in our centers and this shows up under "Command operations." I would guess that of the total research and development work that is supported by these centers, about 10 percent of the command operation funds go into inhouse basic research.

Mr. MAHON. Do you have a tendency to squeeze tightly your basic research requirements in order to make money available for weapons development? In other words, are you being caught up in this web yourself?

Mr. CHARYK. I think that the basic research area shows an increase this year over last year and we would anticipate to have an increase next year. We are trying to gradually move up the level of support in this area.

Mr. MAHON. Do you think that we should move up the level of basic research in relation to development?

Mr. CHARYK. That is a difficult question to answer. I feel that we should gradually increase the support of basic research over the next few years. At such time as we begin to notice that the capability in the country is more or less fully occupied, I think we should level off.

ADEQUACY OF BUDGET REQUEST

Mr. MAHON. Doctor, do you and General Wilson feel that probably the Air Force budget is reasonably adequate in the field of research, development, test, and evaluation? Are we doing what we ought to do? Earlier, we discussed the supporting of projects that were not very important. There is no doubt but what there is a vast number of valid projects that could be, with good reason, supported. Are we supporting essential and urgent projects sufficiently? Is this a sufficiently ambitious research, development, test, and evaluation program for the Air Force?

You are a man of experience. You must have some ideas about this. Do you feel apologetic in your own mind for the size of this program? Is it too big, too little, or what?

Mr. CHARYK. I would say that on balance I think the program is quite reasonable. Naturally, the research people would like to augment the activities in certain areas. Certain people would like to augment the basic research, certain people would like to augment applied research, certain others would like to augment basic weapons development, et cetera. Given the total problem, I think the "Research and development" appropriation as developed here is in reasonable balance.

Mr. MAHON. In other words, regardless of the views of others, you think this is approximately what the Air Force should do at this time in the field of research, development, test, and evaluation within the framework of about a $41 billion defense budget, of which the Air Force is getting approximately $18 billion?

Mr. CHARYK. Within the framework of the total Air Force budget, I think this is a reasonable effort in the research, development, test, and evaluation area.

Mr. MAHON. Do you feel that probably the Air Force budget is sufficiently large, the overall budget—you are talking about this being adequate in balance—do you think that the defense program is sufficiently ambitious?

Somebody said here a few days ago probably we ought to have a budget program of $3 billion or $4 billion greater than this. The Rockefeller report made suggestions somewhat along the line of a larger effort.

What is your feeling for this? Is this adequate for this great Nation, which has a great deal at stake and should take the necessary precautions to defend and protect itself?

Mr. CHARYK. I would have to confine my observation, I believe, to the Air Force program.

Mr. MAHON. I agree.

Mr. CHARYK. Here again I think the Air Force sees certain areas where they feel that additional dollars would be very fruitfully invested. Looking at the problem of the Department of Defense as a whole, the people who are charged with that responsibility on balance have indicated that the Air Force budget should be set at the level that is presented to you.

Within these general guidelines, I think that we are addressing ourselves to the problems that are the most important to the security of the Nation. You can always do more. As you indicated earlier, you can always add additional effort. I think we are doing the things that are fundamental to the security of the Nation.

Mr. MAHON. Mr. Sikes.

MATS MODERNIZATION PROGRAM

Mr. SIKES. I notice you have a substantial amount of money for MATS modernization. What do you propose to do in the way of MATS modernization?

Mr. CHARYK. The amount of money that is in the program is $50 million. The considerations as to the proper investment of these dollars have not been definitized at the present time. Basically, there are two thoughts in this regard. The original thought was to initiate the development of a new aircraft that would meet the requirements

of the different users. We have actually developed the specifications for such an aircraft.

There is considerable interest also in the possibility of applying these dollars to the acquisition of existing aircraft to augment our present MATS capability. A final decision on this has not been made at the present time.

Mr. SIKES. In the main, what do you seek to do? Do you seek to provide more effective airlift, better planes for airlift, or is your thinking directed at other functions of MATS?

Mr. CHARYK. I think the prime purpose of MATS is to provide the required airlift not only to meet Air Force requirements but also the requirements of the other services under various conditions which the Joint Chiefs of Staff deem to be necessary for the security of the Nation.

Mr. SIKES. What is wrong with present day aircraft that you would want to spend $50 million developing new types?

Mr. CHARYK. Actually from the standpoint of operational economics, from the standpoint of being able to accommodate conveniently the types of loads that would have to be carried, none of the existing aircraft really is capable of doing the type of job which is possible within the technical state of the art.

The specifications on the new aircraft are such as to insure an aircraft that would be economical to maintain and operate and that would be able to carry out the various functions that have been assigned to MATS.

Mr. SIKES. You are a very brilliant man, Doctor, and you have been able to cover up whatever you said in such a way that I do not know what you are talking about, if you said anything.

Will you kindly tell me in words of one syllable what you want to do for airlift, for instance, out of this $50 million.

Mr. CHARYK. From a research point of view, I think that we would like to develop a medium-cargo aircraft consistent with the specific operational requirement which has been established.

Mr. SIKES. Established by whom?

Mr. CHARYK. Established by the Air Force and coordinated with the Department of the Army and with the Federal Aviation Agency.

Mr. SIKES. What are some of those characteristics?

Mr. CHARYK. The characteristics would be speed of the order of 440 knots at cruise conditions. It would have certain loadability features such as truck bed height floor, straight-in loading, integral loading equipment.

It would have a payload capability of about 40,000 pounds for a 4,000-nautical-mile range, which would be nonstop across the Atlantic. It would have about 20,000 pounds capability at 5,500 nautical miles, which would be nonstop across the Pacific. At maximum load of 70,000 pounds, it would have a range of the order of 2,500 miles.

These, in general, would be the characteristics we seek to achieve.

Mr. SIKES. If it is decided to build these characteristics into a plane, when would a prototype be available?

Mr. CHARYK. It is estimated that this would be possible in the spring of 1963. Of course, this presents the second problem; namely, the interest of certain people to apply these dollars to the procurement of existing aircraft rather than invest it in a development program which would not produce an aircraft until 1963.

Mr. SIKES. Who will determine whether this money will be used to acquire existing aircraft or whether new prototypes will be built?

Mr. CHARYK. Basically, this will be a decision of the Secretary and the Chief of Staff.

Mr. SIKES. When do you anticipate it will be done?

Mr. CHARYK. I do not have too good information on that. I would estimate it would probably be within a matter of weeks.

Mr. SIKES. Would that affect the place in which this $50 million appears in this budget?

Mr. CHARYK. It is shown in the procurement account. I think that it is therefore not affected.

Mr. FORD. Will the gentleman yield?

Mr. SIKES. Yes.

Mr. FORD. If you go the route of taking the existing aircraft and modernizing them, what is the operational date?

Mr. CHARYK. There are aircraft that are available today that could be purchased to augment our present capability. There are other aircraft that would require comparatively modest modifications.

Mr. LIPSCOMB. If the gentleman will yield, do you mean there are aircraft available today that will qualify to the specifications which you read?

Mr. CHARYK. There are no aircraft that qualify according to the specifications I have indicated. There are existing aircraft which would assist in the modernization of the MATS fleet. They would not have the, shall we describe them as, "ideal" characteristics that I enunciated a few moments ago.

Mr. SIKES. It would be a matter of getting a few additional planes in hand which are very badly needed or of waiting for a better plane which would take a considerably longer period; is that about right?

Mr. CHARYK. This is the kind of decision that has to be made.

HOUND DOG MISSILE

Mr. SIKES. What is the situation on the HOUND DOG? When is it going to be operational?

Mr. CHARYK. The HOUND DOG will go into the operational inventory this year.

Mr. FORD. In quantity, or to what extent?

General WEBSTER. We have two squadrons coming in this fiscal year—one at Eglin.

Mr. FORD. B–52?

General WEBSTER. B–52; yes.

Mr. SIKES. What are the relative comparisons between HOUND DOG and BULLPUP?

Mr. CHARYK. The HOUND DOG is a strategic air-to-surface missile that will be carried, as has been indicated, by the B–52's. The BULLPUP is really a very simple missile for tactical use.

Mr. SIKES. To be used on what aircraft?

Mr. CHARYK. It would be used on F–100 and F–105.

Mr. SIKES. What is the state of its development?

Mr. CHARYK. The BULLPUP, as General Wilson indicated, was originally developed by the Navy. We have had underway a program to introduce certain modifications to permit the adaptation of a nuclear warhead to the original BULLPUP.

Mr. SIKES. What is the relative range?

Mr. CHARYK. I think 50,000 feet for both of them.

Mr. SIKES. Is that the maximum range?

General WEBSTER. That is it.

General HOLLOWAY. That is it. That is the maximum range, slant range, any direction you want to go, straight down, 10° angle.

Mr. FORD. When will it be operational in the configuration or with the operational capability the Air Force wants?

General WEBSTER. Again we expect to have the first unit equipped at the end of this fiscal year at Cannon Air Force Base. It is an F–100 unit.

BOMARC TESTING

Mr. SIKES. Is there any significance to be read by this committee into your statement that the $600,000 is required for BOMARC testing? That would seem to be quite a small amount. Does that mean you are anticipating phasing out this weapon?

General WILSON. That $600,000, sir, is in the P–600 moneys. There are other moneys that come out of the procurement side of the house. I believe General Bradley described these to you. The P–600 money is for completion of SAGE BOMARC compatibility tests.

SKYBOLT MISSILE

Mr. SIKES. What is the situation on SKYBOLT?

Mr. CHARYK. The SKYBOLT program has been actively initiated. We had a rather extensive review of the complete weapon system over the last 6 months. The specifications of the missile have been modified and an active development program has now been initiated.

Mr. SIKES. Where is that program to be carried on?

Mr. CHARYK. I believe the details of the test program are still to be worked out. I would anticipate the actual testing would be done on the Atlantic Missile Range in view of the ballistic character of the missile and in view of its range, but this is not firm and is a matter which will come up for review, I believe, in the next month or so.

Mr. SIKES. When is it anticipated that these test activities will take place? How soon will they begin?

Mr. CHARYK. I would estimate that the first flight tests would probably be in ———.

Mr. SIKES. Is there any maximum and minimum range or just an optimum range?

Mr. CHARYK. One can control the range by controlling the time of burning of the second-stage rocket motor.

Mr. SIKES. What would be the minimum effective range?

Mr. CHARYK. I would guess that the minimum range would be probably on the order of ——— miles.

Mr. SIKES. Does it have capability beyond a thousand miles?

Mr. CHARYK. The capability beyond a thousand miles would be achieved either by improvements in the propulsion system or by carrying a lighter warhead.

Mr. SIKES. What do you anticipate would be the maximum range that could be built into the SKYBOLT?

Dr. CHARYK. This is very difficult to say because it would depend upon the improvements we are able to achieve in propellant perform-

ance. Actually, the specifications on the missile as now conceived are pretty much up to the state of the art and an expansion beyond that would require an extrapolation of our present knowledge, and I would hesitate to do that at the present time.

ANTI-ICBM STUDIES

Mr. SIKES. What is the purpose of the anti-ICBM funds which are in this budget?

General WILSON. This is a study that is being conducted at the Lincoln Laboratories to determine the characteristics of ICBM's in their flight.

Mr. SIKES. What will you do in this that is not already being done by the Army in the NIKE–ZEUS program?

General WILSON. The NIKE-ZEUS program is concerned principally with the portion of the flight on the reentry phase. We were looking at the initial rise phase and the phase through space itself to determine the characteristics of the weapon—that is, the characteristics we could read from the weapon—and see if we could not develop techniques for detecting and tracking both in the rise phase and in the space phase. It is rather basic.

Mr. FORD. Will the gentleman yield?

Mr. SIKES. Yes.

Mr. FORD. This morning Admiral Hayward of the Navy indicated that the Navy had an interest in the TYPHON system for this purpose, as I understand it. Is that correct?

Mr. CHARYK. For the anti-ICBM purpose?

Mr. FORD. I thought he said that.

General WILSON. I had not heard this, sir.

Mr. SIKES. It seems confusing to me that the Army, Air Force, and Navy all are in the anti-ICBM field. It would appear to me that if we are going to have an effective anti-ICBM program—and I am not too optimistic about that—all of this work should be in one area.

Mr. CHARYK. I think our present activities in the anti-ICBM area can be categorized in two parts. There is the NIKE-ZEUS program in the Army, there is also a substantial program in ARPA, Project Defender by name, which is aimed at the exploitation of basic ideas and principles that could provide solutions to the problem.

The interests of the other services, I am sure, are primarily geared to the consideration of military systems that might be based on these basic ideas that are continually being suggested.

General WILSON. If I could comment on this anti-ICBM item we have, it is not a system we are studying. We are seeking now for some fundamentals. This is being done by the Lincoln Laboratory, which is a research organization. It is being done with the complete knowledge and approval of ARPA, to whom this general area has been charged by Mr. Gates.

Also in the operation of the Lincoln Laboratory we have a joint service and ARPA board that reviews their programs. We are not in competition in this particular area. It is just an opportunity for one competent group of people to make a basic contribution that anyone can use.

NEW GULF TEST RANGE

Mr. SIKES. Are there plans under consideration to develop a new test range in the gulf, a triangular range, which would tie in the present Gulf Test Range with a station or facilities or control centers on the coast of Yucatan or of Texas?

Mr. CHARYK. Suggestions along those lines have not come to my office. They may have been considered, but I have not been aware of them.

Mr. SIKES. Does anybody have any information on it?

General WILSON. Not officially, sir.

Mr. SIKES. Unofficially, what do you know about it?

General WILSON. We know it is under discussion. People have been looking at ranges on the coast of Cuba and on the coast of Yucatan and the coast of Texas, but no formal proposal has been forwarded. These people I speak of are the ones in the range business at Eglin.

Mr. SIKES Would this be to secure additional range? Is that the principal objective?

General WILSON. I think their hope would be to find a more economical and effective way of using the facilities along that Eglin coast now.

NUCLEAR-PROPELLED AIRCRAFT PROGRAM

Mr. SIKES. What is happening in the development of the nuclear-propelled aircraft?

Mr. CHARYK. The nuclear-propelled aircraft program has been aimed at the achievement of engine capabilities that would permit the development of a militarily useful aircraft.

Mr. SIKES. Are you familiar with the statement made some few weeks ago by one gentleman, wherein he stated there are in existence small nuclear powerplants which are readily adaptable for this purpose, and that it is a matter of policy that is holding back the development of the nuclear-propelled aircraft and not a matter of the state of the art? Are you familiar with that?

Mr. CHARYK. I am not aware of the statement but I would certainly quarrel with the statement. I do not believe it is correct.

Mr. SIKES. Why do you quarrel with the statement?

Mr. CHARYK. The problem is certainly a technical one. It is necessary to achieve the kinds of temperatures that will result in a militarily useful article and, perhaps more importantly, it is necessary to obtain fuel element lifetimes that would make an attractive system.

We feel it is most important to develop fuel elements and the reactor technology that would have the performance necessary to make it attractive from a military point of view.

The problem from a technical point of view again has been reviewed by a large number of committees and, without exception, they have come back with the recommendations that more work needs to be done to improve the present technical state of the art.

Mr. SIKES. Would it be your guess that we will have such an aircraft about 12 months after the Russians get one? It is a fairly safe assumption, is it not, that we will go to work in earnest when they announce they have flown one?

Mr. CHARYK. I think there is a difference here between actually flying in the strict sense of the word with a nuclear powerplant and having a nuclear powerplant that is attractive from a military point of view. I think we could proceed now to do the former. I do not think the technical state of the art has reached the point where we can do the latter.

Mr. MAHON. May we have the movie now?

(At this point a movie was shown.)

Mr. MAHON. Thank you very much, gentlemen. We will resume the hearing tomorrow morning at 10 o'clock.

FRIDAY, MARCH 18, 1960.

UNOBLIGATED CARRYOVER

Mr. MAHON. We will resume our hearing.

Mr. Secretary, it is a little difficult to understand why the unobligated carryover in the Air Force is so much greater than in the other services.

Mr. CHARYK. I think General Friedman might address himself to that question.

General FRIEDMAN. Yes, Mr. Chairman. As you have noticed, we have an unobligated carryover of $164.2 million. The basic difference between this year and previous years is the fact that there is an amount of $59 million which is not committed and which is being carried forward within that total unobligated balance to finance the fiscal year 1961 requirement as a deduction in lieu of request for new obligating authority.

There are two reasons for this. The first is that there were certain programs on which it appeared that the rate of effort was questionable and, therefore, there were lesser amounts put against those programs than initially contemplated.

Then the remaining reason was due to the fact, that under the guidelines for the makeup of the 1961 budget, we felt that this was an area which, on balance, would help us with our reprograming effort in the 1960 program.

Mr. MAHON. I wonder why the Navy and the Army did not have this same problem. Do you know?

General FRIEDMAN. That is very hard for me to say. I would have to take a look at their fiscal picture.

Mr. MAHON. It would seem that you are all working under the same guidelines.

General FRIEDMAN. We were working under the same guidelines, but I believe that if you were to view them service by service, the very nature of the guidelines themselves was such that it was, at least in my opinion, more difficult for the Air Force to conform to them than the other services.

Mr. MAHON. Will you be a little more specific.

General FRIEDMAN. Yes, sir. You will recall, as Mr. Gates testified, the basic budget submission was predicated on the premise that the amounts to be assumed available for procurement, research, development, test, and evaluation, and construction would be set at 10

percent below that appropriated for those same accounts in fiscal year 1960. Of course, the Air Force had a much larger procurement program, so that the 10 percent reduction and application of expenditures against that reduction would have been greater, percentagewise, in the instance of the Air Force.

Mr. MAHON. What do you anticipate will be the situation hereafter? In other words, can we expect that a carryover of about $160 million will be normal?

General FRIEDMAN. For next year we are projecting an unobligated balance of $160 million. Therefore, the situation remains approximately the same, Mr. Chairman.

RESEARCH, DEVELOPMENT, TEST, AND EVALUATION FUNDS IN PROCUREMENT ACCOUNTS

Mr. MAHON. I am not sure of the statement which I am about to make, but I understand that probably the Navy and the Army have put substantially all of their R.D.T. & E. funds in that category in the budget. In a statement made by General Wilson you explained that you were putting a few hundred million dollars more this year in R.D.T. & E and taking it out of the procurement account, but there yet remains a lot of money in the procurement account that technically belongs in the R.D.T. & E. account; is that correct?

General WILSON. That is correct, sir.

Mr. MAHON. How much money yet remains in the procurement account that has not been transferred?

Mr. CHARYK. For fiscal year 1961 the R.D.T. & E. account would be of the order of a billion dollars. The bulk of this, of course, is in the missile program, in ATLAS, TITAN, and the MINUTEMAN.

Mr. MAHON. Is it visualized that hereafter big projects like that, if we have such projects, will be in R.D.T. & E. or in procurement?

Mr. CHARYK. The feeling has been up to the present time that large programs of this type that are intended for the inventory would, by and large, be carried in the procurement account. If the item is such that there is some uncertainty as to its final inventory status, then it would be in the R.D.T. & E. account.

Mr. MAHON. Is that policy consistent with the policies of the other services, or do you know?

Mr. CHARYK. I believe we are all somewhat in a transition stage, moving more things over into the R.D.T. & E. I think that in the case of the Navy their aircraft program is very similar to ours.

General FRIEDMAN. That is correct, sir.

Actually, the reason for as large an amount as we are discussing here—on the order of a billion dollars—as the Secretary indicated, was because those programs, by and large, were already started in the other appropriation area. It is a transitory situation.

Mr. MAHON. But do you think in the future that they would probably fall into the R.D.T. & E.?

General FRIEDMAN. From an Air Staff point of view, when this revised structure was developed—and this was an Air Force proposal, incidentally, you will recall last year we discussed this—we at that time at least, and this is subject to additional study by the Secretary and others, thought that the cleanest break would be on whether or

not you were intending to produce an item for issue to troops or whether or not it was a purely development type project.

We recognized there were problems in administration which, on further study, may not be as restrictive as we initially thought.

I think General Wilson and the Secretary are probably better versed in this aspect of the thing than I.

Mr. MAHON. What would you say, General Wilson?

General WILSON. I feel, sir, there is a tendency to put more and more funds on the research and development side rather than on procurement.

In the future it does appear to me that we can anticipate more and more of these moneys being included in the R. & D. account.

Mr. MAHON. I do not have too strong a conviction as to precisely how this ought to be handled. I am just trying to explore what you are doing and also what you are doing in relation to the other services. It would seem that under similar circumstances and conditions anything that would be good practice for the Navy or the Army would likewise be good practice in the Air Force.

General WILSON. This situation really is based on expediency. This at the moment seems to be a useful and economical way to manage our moneys. But in the Air Force today we are restudying our management processes, and there is considerable indication that more and more of the management responsibility will be transferred to the research and development side of the house.

Mr. MAHON. Is that good?

General WILSON. The matter is still up for study. I personally think it is good; yes, sir.

Mr. MAHON. Do you think multibillion dollar projects involving procurement of missiles and aircraft lend themselves to better management in R. & D. than in the procurement field?

General WILSON. I hate to make heavily qualified statements, but to go back to the principle, it seems that we would get the best management if, when we set up a weapon system, we designate one officer as responsible for that system until the item gets into inventory.

Mr. MAHON. You mean like General Schriever on the ATLAS?

General WILSON. Yes, very similar. If this were so, in order to have him do his job properly and in order for us to hold him responsible, we would have to give him all the necessary tools. This would include the money for the job. We have not gone completely this way, but it is under study and the indications are that we are heading in that direction.

MANAGEMENT OF B–70

Mr. MAHON. What do you propose to do on the B–70? What are you doing on the B–70?

Mr. CHARYK. The B–70 dollars are shown in the "Procurement" account for 1961.

Mr. MAHON. Does that make sense?

General FRIEDMAN. I think perhaps a partial answer to that, Mr. Chairman, is that although it is shown in the "Procurement" account and all this billion dollars we are talking about is specifically earmarked as D.T. & E. funds—in other words, they are not merged

with the aircraft procurement moneys, they are specifically set out separately from what you would call pure procurement.

Mr. MAHON. They are set out within the procurement appropriation?

General FRIEDMAN. That is correct, sir, under a program title of "Development, test, and evaluation" support.

Mr. RILEY. Mr. Chairman.

Mr. MAHON. Mr. Riley.

Mr. RILEY. I would be interested in knowing whether or not they have assigned an officer to follow through on the B–70, as they did on the ATLAS.

General WILSON. We are in the process of doing just this; yes, sir. There is a project officer in the Pentagon who is following it from the staff point of view. The weapon system manager is being set up at Wright Field.

The program, once again, is a little transitory but we do have a responsible officer at the moment.

I think, to respond further to the money problem, as far as the development people are concerned, we know the money, although it is labeled procurement account, is available for the research and development.

MANAGEMENT OF R.D.T. & E. PROGRAM

Mr. MAHON. How do you evaluate the present research and development system in the Department of Defense, Dr. Charyk?

Mr. CHARYK. I think, Mr. Chairman, that there has been a considerable improvement in the general direction of research and development in the Department of Defense over the past few years.

In particular, the establishment of the Office of Director of Defense Research and Engineering has been very salutary. As I indicated in my statement yesterday, rather strong relationships have been developed between the responsible individuals in the three services for research and development and working with the Director of Defense Research and Engineering, I think we have a research and development picture that is a considerable improvement over the picture that existed, let us say, 2 or 3 years ago.

Mr. MAHON. You do not feel that Dr. York's shop hobbles or hamstrings Air Force operations in research and development?

Mr. CHARYK. No, I do not believe so. I think that the relationships there are excellent, and actually I think that, by and large, they work in the direction of assisting the Air Force.

Mr. MAHON. Do you think they tend to slow down programs or tend to expedite programs?

Mr. CHARYK. It works both ways, Mr. Chairman. On certain programs there are questions raised by Dr. York's office which, in a sense, might be said to slow down the effort. In other cases there is a stimulus applied from his office to expedite other activities. It works both ways.

Mr. MAHON. You are not unhappy with this kind of system?

Mr. CHARYK. I think the particular setup is working extremely well.

Mr. MAHON. Does Dr. York apparently have a staff of adequate competence to deal with these questions?

Mr. CHARYK. He has a number of top people who are extremely competent.

EXCESSIVE DEVELOPMENT LEADTIME

Mr. MAHON. We have had discussions with various witnesses in regard to the question of leadtime. If there is too much delay between the conception of a weapon and when it becomes operational, it may not serve the purpose for which it was designed very adequately by the time it becomes operational.

Are you concerned or disturbed by this leadtime problem, or do you think it is a natural thing that is inevitable and that we have to live with it?

Mr. CHARYK. Actually, this is a very important question. I endeavored to address myself to it, at least in part, in my statement in which I indicated that if one applied the so-called principle of concurrency in all cases, this would be a rather wasteful and inefficient procedure, as a general rule.

Mr. MAHON. I think at this time it would be good for you to outline for the record what you mean by the principle of concurrency. I think I understand precisely what you mean, that you would develop all phases of a program as you go along, assuming from the beginning that it is going to work.

Mr. CHARYK. That is absolutely correct. You not only proceed with the actual development, but do all of the necessary construction, development of young ground support equipment, training of troops, all of the elements that are necessary to produce an operational system. This is all scheduled and carried out together.

Mr. MAHON. Proceed with your response.

Mr. CHARYK. My point was that in certain very special cases where the product is of vital importance to the security of the country I think that the principle of concurrency can be applied and must be applied in order to accomplish the desired results in the shortest possible time.

Mr. MAHON. Would you include in that the B–70?

Mr. CHARYK. I would not include the B–70 in that category.

Mr. MAHON. The ATLAS was included in that category?

Mr. CHARYK. The ATLAS was.

Mr. MAHON. And also the POLARIS?

Mr. CHARYK. I believe that is correct.

Mr. MAHON. Did that make sense, in your judgment?

Mr. CHARYK. I think in those two cases the character of the weapon system is such that they can have a very significant impact on our deterrent posture and because of the leadtime that the Russians had in this area, I think it was extremely important to develop an operational capabilty at the earliest possible date.

To follow on my earlier remarks, I think that if one went to the other extreme and tried to solve all of the development problems before initiating any of the operational aspects, the leadtimes would become prohibitive and, by and large, our weapon systems by the time they were introduced into the inventory would be obsolete.

So that in each individual case I think a keen sense of judgment is required to determine how far we should go between, on the one hand, the minimum risk approach and, on the other hand, the application of the principle of concurrency in the full degree.

Mr. MAHON. Are you of the opinion that we are doing fairly well in that field at this time?

Mr. CHARYK. I think that we have improved a great deal and that our situation today is considerably better than it was a few years ago.

Mr. MAHON. Do you think it can be substantially improved?

Mr. CHARYK. I think further improvements can be introduced.

Mr. MAHON. Will they be substantial?

Mr. CHARYK. I think it becomes really a question of bringing the proper technical considerations into the picture at all stages of the program so that one can adjust up or down, depending upon how the program is proceeding.

Mr. MAHON. People keep saying our opponents can originate an idea and have an operational weapon in 4 years and we fiddle around for 5 to 10.

Mr. CHARYK. I think in the case of the ATLAS, for example, we can be very proud of the results that have been achieved in a very short time comparatively with an extremely complicated weapon system.

Mr. MAHON. About what was the period there?

Mr. CHARYK. The program was put into high gear in approximately 1955, and in 1959 we had an initial operational capability.

Mr. MAHON. Some witnesses have talked to us about the problems of long leadtime and have used such terminology as overcomplexity, indecision, too frequent refinements by perfectionists, ascribing things of this type as reasons for the long leadtime. What is your opinion as to the validity of that statement?

Mr. CHARYK. I am sure the factors you have mentioned do have validity in certain cases.

Mr. MAHON. To what extent is the "too much refinement which is demanded by perfectionists" entering into the picture?

Mr. CHARYK. I think there is some. In certain programs there has been a tendency to keep introducing refinements so that the operational date keeps being delayed more and more. Here again, there has to be a keen sense of judgment applied as to just where you stop and actually proceed to get an operational capability, even if it will not do all of the things that the technical state of the art might permit.

Mr. MAHON. If it will not do all of the things, you must be sure it will do some of the things.

Mr. CHARYK. It has to perform a useful military function, to be sure.

TERMINATION OF LAGGING PROGRAMS

Mr. MAHON. When obsolescence overtakes a vehicle in its early phases of development or operational capability, do you think we have a tendency to throw good money after bad and cling to programs too long because we do not have the courage to cancel them?

Mr. CHARYK. I would say that the most difficult problems we face are probably those where we have proceeded in a direction toward the concurrency end of the spectrum. We then discover that all of the technical assumptions are not being realized, so that the full military potential that we might have envisioned is not going to be realized.

If we are really applying the principle of concurrency in the full degree, there will be operational facilities that will have been developed that now cannot be properly utilized. I think that it is im-

portant that if that situation develops, we do address ourselves to the proper course of action rather than attempting to drag the thing out.

Mr. MAHON. How well do we do on that, in your opinion?

Mr. CHARYK. I think it varies, depending upon the situation and depending upon the program.

Mr. MAHON. How well did we do on the NAVAJO? I do not want a long discussion of that, but did we chop that off soon enough?

Mr. CHARYK. I think that the NAVAJO had certain derivatives which were actually quite important.

Mr. MAHON. We will not argue about that. It did have derivatives that we concede to be important. My question is: Did we pursue that program too long?

Mr. CHARYK. I am inclined to feel it should have been terminated earlier but with the retention of some of the important elements in the program that did have an impact on other things such as the ballistic missile program.

Mr. MAHON. What about the F–108?

Mr. CHARYK. This is a completely different situation, in that the F–108 was a complete weapon system designed to counter a specific military threat. Actually, from a technical point of view, the program was proceeding very well. It really became a consideration of the importance of that military threat in the time period in which you would have the weapon system.

Mr. MAHON. The fiscal situation entered heavily in that situation, I assume.

Mr. CHARYK. It was certainly an element. The other element was the role of this weapon system in the time period in which it would become available.

Mr. MAHON. I could pursue this further, but my object is to try to highlight the idea that this is an important field where billions can be lost or won, more or less, as I see it.

Mr. CHARYK. I think it is an extremely important question.

B–58 PROGRAM

Mr. MAHON. What is your thought, General Wilson, on the B–58? Have you come to a conclusion on whether or not we should go to the so-called B–58X, the improved version, so-called?

General WILSON. Our feeling is that the B–58X is only an incremental improvement over the B–58. It is a program which, if you produce enough of these airplanes to get the cost down to a unit cost comparable to the B–58A, would call for about three wings, a program of about $2.5 billion.

This gives us a choice, really, of using that amount of money to double the force of the B–58A in about 2 years, or adding three wings of B–58C in about 4 years or spending that money for something that represents more than an incremental advance. Our feeling on the Air Staff is that it really is not worth $2.5 billion.

Mr. MAHON. What is not worth $2.5 billion?

General WILSON. The B–58X, because the airplane adds another type to the inventory, with all the complications of the additional type. The airplane does have better performance than the A, but it is still not an intercontinental airplane and still has to have tankers or advanced bases. Our feeling is it just does not have enough advantage over the B–58A to warrant a large expenditure.

Mr. MAHON. The A program with less than 200 planes—they always cut that out of the record for some foolish reason—will cost more than $2 billion?

General WILSON. The present program?

Mr. MAHON. Yes.

General WILSON. I was speaking of adding the B–58X to the present A. Yes; that is correct.

NUMBER OF AIR FORCE R.D.T. & E. PROGRAMS

Mr. MAHON. How many programs broken down into detail in research, development, test, and evaluation do you have in your fiscal 1961 budget? I thought in your statement, General Wilson, you did a good job of giving some detail on a large amount of material.

General WILSON. I have not totaled this up. We can very easily do so.

General FRIEDMAN. Do you mean fiscal breakout?

Mr. MAHON. Number of projects, those that the universities and others are doing.

Mr. CHARYK. You mean a tabulation of all programs?

Mr. MAHON. Yes, the number, not necessarily a description, just the number. Is it a few thousand?

General FRIEDMAN. I would say they are about that numerous. We have a report on it by company showing the obligations and expenditures against each of these contracts by company, which we certainly can make available.

Mr. MAHON. I believe the staff has a copy of that and they say it does not mean very much to them. Do you have a list of the projects with a little description other than this one?

General FRIEDMAN. No, sir; we do not.

Mr. MAHON. General Wilson, do you actually know how many projects you have and what they are all about, or is it so big you cannot keep up with it?

General WILSON. We have this information available and can furnish it to the committee. I was hopeful we would have the answer with us here, but apparently we do not. May I furnish it?

Mr. MAHON. Yes. Give us the best answer you can.

(The information to be supplied follows:)

Summary of projects and system action during fiscal year 1959

	Number of projects	Number of systems		Number of projects	Number of systems
Total active, July 1, 1958	720	55	Suspended	0	−10
Canceled	−117	0	Implemented	+415	+24
Completed	−110	0			
Superseded	−93	−6	Total active, July 1, 1959	815	63

As indicated in the above table, at the beginning of the current fiscal year there were 815 active projects being monitored by the Air Force. This total represents at the present time the best manageable division of the research and development program. While the number of projects is large, it must be considered in its proper context. The Air Force has approximately 133 military and civilian staff officers assigned to the Office of the Deputy Chief of Staff, Development, Headquarters USAF. One of their major responsibilities is the review of these projects and systems to insure that the contract is in consonance with the overall objectives of the Air Force.

POSSIBILITY OF SOME RESEARCH PROJECTS NOT REING OF ANY VALUE

Mr. MAHON. We made reference yesterday to foolish things done in the name of research and development. We do not have time to go into each and every project. Congress provides the money and undertakes to influence policy somewhat, but it is up to the Administration to see that you are doing things that are desirable and are of sufficiently high priority.

Yet we read in the paper of an Air Force manual which is very poorly written and in which the writer paints with a broad brush on subjects far and wide. In some cases he makes the Air Force look ridiculous and he discredits the Defense Establishment to some extent.

Among other things, he denigrates the Air Force big bomber program, saying that the Air Force is made up of a bunch of saps that fell for the Russian propaganda that they were going to go into a big bomber program, which was just a ruse to throw us off balance, and which we swallowed hook, line, and sinker. You understand what I mean.

General WILSON. I understand.

Mr. MAHON. Have you read that?

General WILSON. I have not seen this particular one.

Mr. MAHON. It is very interesting. Yet nobody at the top seems to know about this. I pointed this out to Secretary Sharp. I suppose the man could be right.

I want to ask you if you know enough about these programs to make sure that you are not doing perfectly absurd, ridiculous, indefensible things which would bring you into disrepute and discredit you if the facts were known to the public.

Mr. CHARYK. I might comment, Mr. Chairman, to this extent.

What we have attempted to do during the past year has been to take the entire applied research area, which involves several thousand separate contracts—and which is broken down in a functional fashion, and I have set up a series of reviews, taking each subarea of the applied research area and reviewing in a broad sense the total program structure, the types of things we are attempting to do, and in general the coverage we have in that area. Then we have attempted to get a feel for the balance between the different subareas.

In addition, there is required a secretarial determination and finding on each individual program in excess of $100,000, so that the individual papers come to my office for signature.

Mr. MAHON. I know that a few years ago we had some argument about one of the projects you had in which you were crashing automobiles in order to try to do something about the alarming rate of injury to personnel caused by automobiles. We are all worried about automobile accidents, but it did not seem to be the particular job of the Air Force, which has such a tremendous responsibility in the military field. I just want to know if there are things like that still in your research and development program.

Mr. CHARYK. We are doing everything we can to go over the complete program and to try to ferret out individual items which for various reasons might be inappropriate activities in our applied research effort. Actually, the total applied research effort is broken down into 27 separate categories ranging from, for example, materials through human performance, radio biology, and so on.

Mr. MAHON. I would like for you to provide the committee with a statement of the types of projects having to do with the humanities, the things that may be considered to be significant from a military standpoint, but which at first blush by the uninitated would not appear to be so significant. I want to have a look at those kinds of programs dealing in human relations, and so forth.

I suggest, Mr. Secretary, that you make sure that these kinds of programs are looked into. There may not be much money wasted, but it is important not to appear ridiculous in the eyes of the public if you have an important responsibility because it impairs your effectiveness.

Mr. CHARYK. I certainly agree with you.

(The information to be supplied follows:)

The Air Force conducts no research that could be properly described as falling into the field of humanities as the term is understood in academic circles. However, we do engage in research to improve the performance of our Air Force personnel in the following areas:

(*a*) Man-machine systems and human engineering studies.

(*b*) Performance of Air Force units such as crews, teams, control and warning center groups and other units performing critical functions.

(*c*) Studies of human psychological functions involved in performance of military tasks such as learning, retention, reliability of performance, decision making, and performance in adverse and stressful environments.

(*d*) Studies of the impact of air weapons on target populations and the development of techniques to measure and exploit the psychological potential of air weapons. The results of these studies are useful in evaluating air weapon systems, and in proposing concepts for evaluation and implementation by the State Department, National Security Council, and the Operations Coordination Board.

ANALYTIC SERVICES, INC.

Mr. MAHON. You have a million-dollar program for Anser, Analytical Services, Inc., a study group operating directly in support of Headquarters, U.S. Air Force, for purposes of assisting in quick evaluation of development planning problems. Who is in this group, what are their salaries, is this the first year this group will be used, how many man-hours of work will you get for $1 million?

General WILSON. I would like to provide the committee with some of these figures that I do not believe I have at the moment. I would like to describe what this organization is to tell you what we expect for a million dollars.

Frequently suggestions or proposals are made from various sources to the Air Force that we have no means of evaluating properly. An example of this was an occasion last year where it was reported to us that Mr. Kapitza in Russia had developed a means for controlling balled lightning. If this were true, it meant that it represented a complete void in our technology and that the Russians once again were very much ahead of us. We needed someone, we did not have the capability ourselves, to cope with the problem of this sort. We called on the Anser people. This is a group of scientific people. They were able to run the facts down.

The report apparently came out of the Russian equivalent of Popular Mechanics. We convinced ourselves that there was nothing in it. This saved us, we felt, a lot of time and trouble.

Mr. MAHON. What about the Central Intelligence Agency and your own intelligence? It looks as if it ought to be better than any other organization in the business.

General WILSON. This was a technical problem.

Mr. MAHON. But CIA deals in technical fields.

General WILSON. Here we were as much concerned about the possible lack in our own technology as the advance in Russian technology. We had to take a look at the state of the art. This is what it amounted to.

Mr. MAHON. Will you supply for the record definitive answers embodying the questions I asked?

General WILSON. Yes, sir.

(The information requested follows:)

Analytic Services, Inc., is a group of scientific and technical personnel whose primary purpose is to furnish assistance to the Deputy Chief of Staff, Development, by accomplishing quick evaluations of proposed weapon systems or proposed solutions to technical problems involving development planning. Additionally, on a continuing basis, because the mission of the DCS/Development includes preparation of development plans for long leadtime systems and concepts, Analytic Services supplies valuable technical inputs to these plans. The long-range program is, of course, interrupted in order to concentrate required attention on evaluations of immediate urgency.

As indicated on the attached personnel and salary summary, Analytic Services consists basically of 39 professionals and their necessary support. Fifteen have advanced degrees. The president is Dr. Stanley J. Lawwill and the vice president is Dr. Peter A. Cole. These scientists are widely recognized in the fields of operations analysis and weapon system evaluation, each having academic, industry, and military experience. Dr. Lawwill receives an annual salary of $28,000; Dr. Cole, $20,000; and Mr. W. R. Longanecker, assistant to the president, receives $11,000.

Analytic Services, Inc., a not-for-profit corporation, has been in existence since July 1958. During the approximately 1½ years of operation, we have found that Anser has contributed materially toward timely and valid development planning decisions. Because of its already demonstrated contributions, we consider that the $1 million this year represents optimum use of development planning funds and funding of at least this amount is desirable for the foreseeable future.

Anser personnel summary, as of Feb. 15, 1960

	Number	Degrees			Total years experience
		Ph. D.	M.A.	B.A.	
Direct personnel by skill:					
Aerodynamicist	1		1		8
Chemist	1		1		21
Economist	2		2		18
Aeronautical engineer	6		1	5	42
Civil engineer	2			2	43
Electronic engineer	6			5	62
Mechanical engineer	3			3	31
Mathematician	10	1	3	6	136
Physical chemist	1	1			26
Physicist	7	2	3	2	113
Technical support	11			4	102
Subtotal	50	4	11	27	602
Indirect personnel	10	1	1	4	141

The breakdown by function and average monthly salary of the direct personnel is as follows:

6 supervisors at $1,380 per month.[1]

33 analysts at $897 per month.

11 technical support at $416 per month.

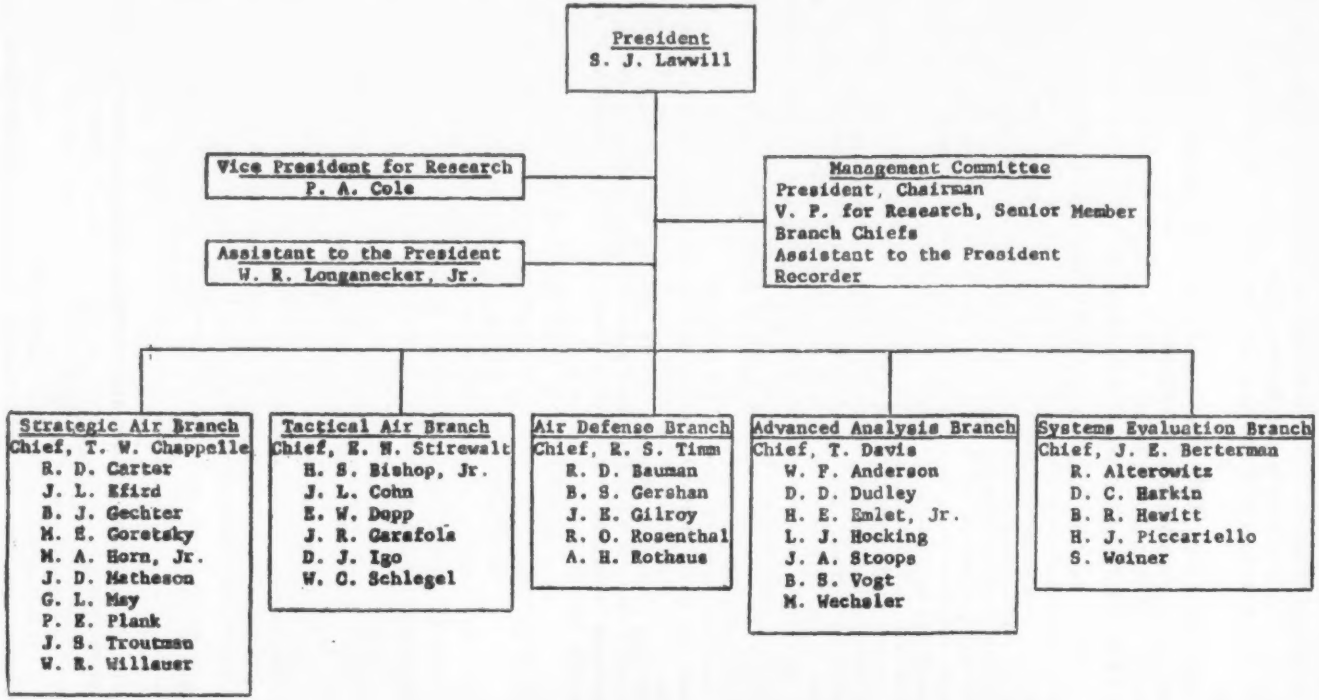
The salaries of the indirect personnel (executive, administrative, and support) average $615 per month.[2]

[1] Includes salary of assistant to the president.

[2] Includes salaries of president and vice president.

ANALYTIC SERVICES INCORPORATED

ORGANIZATION AND KEY PERSONNEL



Mr. MAHON. Mr. Sheppard.

Mr. SHEPPARD. With respect to your research and development funding request which is presently under consideration, in order to give me some education which I am very difinitely in need of at the moment, what comes first in the procedure? Is research the first and basic thing in your requirements?

Mr. CHARYK. Actually, Mr. Sheppard, we think of our total program in four parts: Basic research, applied research, advanced development, and finally complete weapons systems.

Mr. SHEPPARD. But before the development, obviously much research has to be done.

Mr. CHARYK. That is correct. The basic and applied research programs provide outputs which permits decisions to be made relative to developments which can have important military utility.

One of our main responsibilities, of course, is the determination of the appropriate balance among the four areas which make up the total program.

Mr. SHEPPARD. They should be in balance, and I take for granted that is an absolutely correct statement. Again, the basic and very first thing must come out of the elements of scientific research.

Mr. CHARYK. That is correct.

Mr. SHEPPARD. All right. Then the next step is development. Is that correct?

Mr. CHARYK. I would say that it would be the application of the scientific principles that were established in the basic research program being applied, let us say, to a component or a subsystem which then subsequently becomes part of a complete weapons system.

Mr. SHEPPARD. What I am trying to segregate for the purpose of my own understanding and for the record, Mr. Secretary, is the respective steps in the procedure and where, for example, your test evaluation enters into the combination of the elements. I mean by step chronologically. Is it possible to make a step-by-step explanation?

Mr. CHARYK. Let me attempt that, Mr. Sheppard.

Actually, we feel that a virile basic research program is fundamental. Out of the basic research program will come ideas and principles will be established. These are then exploited in what we call the applied research programs. This is the application of, let us say, several ideas or several principles to try to develop a capability which might permit the accomplishment of new tasks which in the past were not possible.

As the ideas are developed further, there may be the need actually to build a so-called breadboard model, as we call it, to demonstrate that all of the pieces fit together and perform a job. If that is successful, we then have a basis for an actual development.

Mr. SHEPPARD. Is that not a premature step in the development when you walk into the mockup category?

Mr. CHARYK. I think the advanced development category, the third category I mentioned, is just this: It is an application of the idea before a decision is made on a complete weapons system, an actual demonstration that the problems are in hand before one launches on a complete weapons system development.

Mr. SHEPPARD. Assuming we pursue the steps which you have explained to me, then following development, do test and evaluation become a combination procedure, or is evaluation done and then testing for operation or production purposes? I am trying to get these categories in their respective positions as definitively as I can. Perhaps my questions are not properly formulated to accomplish that purpose.

Mr. CHARYK. Actually, I think we go back and forth to this extent: A particular test will reveal certain information which permits a new evaluation to be made. This then leads to new changes in the system, which are then again tested and a new evaluation is made. So it is a back and forth process until we have accomplished the ends that were set out as our goals.

SIZE OF R.D.T. & E. APPROPRIATION

Mr. SHEPPARD. With the recent change in your funding process from procurement into research and development, I have been somewhat concerned upon the following premise: It appears to me that we are getting a pyramiding here. Perhaps it is purely psychological. We are getting a pyramiding of funds built up for research and development, and then we bring in some collateral "cats and dogs," if I may use that terminology, which depreciate the actual value expenditurewise in research and development. In other words, sitting on this side of the table and from my point of view, here comes X amount of dollars for research and development. Being uninformed in the procedures to which I have just referred, I mean in the step-by-step aspect, I begin to think—wait a minute. How much of this is going into literal research as compared with the other aspects which are being interjected into the funding program.

Am I making my thinking clear to you, sir, or not? Maybe my concern about this is completely unfounded.

Mr. CHARYK. Perhaps your concern is directed to the way that the funds are distributed among the various parts of the total program.

Mr. SHEPPARD. I will be perfectly frank with you. The inclination on the part of this side of the table is to look for money to cut. When you see a large amount of funds in certain categories and you do not have those categories broken down for each contributing part of the total, so you can see what it means, and it becomes a gross situation, then if you are not careful you reach an apex and you start chopping at the peak of it. I am just wondering if this might have a psychological influence here which somebody is overlooking. The more you put under the guise of research and development, the more you may be inviting a reduction, particularly under a tight budget concept.

(Discussion off the record.)

Mr. SHEPPARD. You have just expressed a very frank and honest opinion.

General FRIEDMAN. We recognize that there is a limit to what you would include in a single appropriation. For example, it would be very advantageous from the standpoint of flexibility insofar as the services are concerned, to have a single procurement appropriation. When we arrived at our proposed budget structure change, which we

discussed with you last year, we came up with three procurement appropriations rather than two, recognizing the fact that large amounts are, shall we say, more susceptible to reduction than smaller amounts.

Mr. SHEPPARD. It is quite frequently invited.

Mr. FORD. Will the gentleman yield there?

Mr. SHEPPARD. Yes, sir.

REQUIREMENT OF ANNUAL AUTHORIZATION FOR MISSILES, AIRCRAFT, AND SHIPS

Mr. FORD. I think within the last year, unfortunately from my point of view, we have gone the other way with this unwise decision to require annual authorization of specific weapons systems for operational missiles, aircraft, and ships. This will tie down and restrict rather than loosen up and assist the programs that are, in my opinion, necessary for all three services if we expect to get them on the operation line more quickly.

General FRIEDMAN. We are very much concerned and, as a matter of fact, I made a presentation to the committees of both Houses which are very much interested in the establishment of authorization prior to appropriation. I attempted to point out the very difficult situation which the services and Defense might find themselves in unless this were handled on an extremely cautious basis.

Mr. FORD. If we want to cut down leadtime, we are going in the wrong direction with this requirement for an annual authorization.

General FRIEDMAN. I think, as this committee is aware, we did have in prior years the matter of contract authorization and then appropriation, and it was not a very workable situation.

Mr. SHEPPARD. I take exception to the comment of my wonderful friend from Michigan, Mr. Ford, to this degree: The flexibility is a component part of the leadtime, you are right. I think if you get right down to the rudiments of the situation you will find that due to many uncontrollable factors your planning does not become apparent to the point of expeditiously spending the funds which you have available. Would my friend, the Comptroller, take a different attitude from my comment on that aspect of it, which is your privilege?

General FRIEDMAN. This has occurred, but I think there is the question of flexibility. It depends on the administration of the authorization. If you were to do it on a line item basis, I think the results would be disastrous. If the authorization is broad in scope and if the administration of that authorization is such that you can parallel the appropriation and the authorization accounting, then the problems from the service standpoint are not insurmountable. This was the burden of my statement. I believe that the Armed Services Committees, at least after each of their hearings, did recognize this particular problem and indicated that they would work with the Air Force to attempt to come up with something which did not require a duplicate accounting system.

Mr. SHEPPARD. I agree with Mr. Ford, and also with your comments on that with respect to the leadtime. It is a very expensive situation. The question is how much of it can be obviated. There are so many interjections into this total picture which contribute to the long lead-

time problem, I think many of them could be refined out very rapidly. For example, right now in the budget which we have before us, I can only assume—I have not analyzed it completely—much of it is anticipated expenditures. You have to do that to be prepared to take care of eventualities after the eventuality is determined. That is a component part of this budget, too, is it not?

General FRIEDMAN. I so testified previously.

Mr. SHEPPARD. If all of the plans you have here were definitized to the degree of an expenditure and then you could have the money released to you by those in control of the money as expeditiously as the Congress gives it to you, that would also have a tendency to diminish the leadtime; would it not?

General FRIEDMAN. I think it goes without saying, sir, the more rapid the decisions, the more rapid the release of the funds, the more rapid the receipt of the end product—excluding consideration of technical difficulties or over optimism in initial planning.

ESTABLISHMENT OF R.D.T. & E. APPROPRIATION ACCOUNT

Mr. SHEPPARD. To get back to my original question, which I do not wish to belabor unnecessarily, it does occur to me that the more we add to the research and development appropriation, it will be rather obvious what the end result will be. I am not saying that based upon an assumption at the moment. May I say to my friend, the Comptroller, you have been dealing with the Congress a long time and you know the pattern as well as I do. This is a pattern which has been in existence over a long period of time. When it comes to the restriction of funds, and particularly when we go to the American public, some others might be inclined to think the Congress was stupidly permitting funds to be released for unnecessary purposes. These are all a part of the psychology we have to live with. I personally hope that this research and development fund does not become loused up, if I may use that terminology, with a lot of "cats and dogs" which may ultimately reduce your funding requirements, because to me, from my own point of view, speaking for no other member of this committee, I think research is one of the prime and important factors. I think the transition which has taken place scientifically in the last 10 or 15 years fully justifies the position I am taking. However, that is not a matter of your own executive and administrative decision here. It is your problem and you are living with it.

I am concerned about seeing adequate funds provided in this particular category and allocated for that purpose. Let us let the overshoes and neckties take care of themselves.

That is all, Mr. Chairman.

Mr. MAHON. Mr. Andrews.

BOMARC TESTING

Mr. ANDREWS. Mr. Secretary, I notice on page 31 of your document that Air Defense System funds will be used for BOMARC, and final testing of the BOMARC long-range interceptor system will be completed in fiscal year 1961. Are you still spending R. & D. money on BOMARC?

Mr. CHARYK. Actually the R. D. T. & E. expenditures are very modest in fiscal year 1961, amounting to $0.6 million.

Mr. ANDREWS. The answer to my question, then, is yes, that you are still spending this R. & D. money on BOMARC.

Mr. CHARYK. To that extent.

Mr. ANDREWS. Does that mean, then, that the bugs have not been removed from BOMARC?

Mr. CHARYK. I think certainly it is fair to say the bugs have not been removed from BOMARC-B.

Mr. ANDREWS. What about BOMARC-A? That has gone overboard, has it not?

Mr. CHARYK. BOMARC-A has been performing satisfactorily, by and large.

Mr. ANDREWS. Will you elaborate a little on that "by and large"?

Mr. FLOOD. When, where, at what base or bases, at what range, and so on?

(Off the record.)

Mr. CHARYK. There have been many successful firings of BOMARC-A.

(Off the record.)

Mr. CHARYK. I might remark that we have, of course, been studying in a rather intensive fashion the whole air defense question, and the presentation which the committee will hear is a reflection of that fact.

Mr. ANDREWS. Just one other question, Mr. Secretary. Is it true that the production of BOMARC was started before the research, development, test, and evaluation of the missile had been completed?

Mr. CHARYK. That is correct.

Mr. ANDREWS. That is all.

Mr. MAHON. Mr. Riley.

Mr. RILEY. I have no questions.

Mr. MAHON. Mr. Flood.

SAMOS PROGRAM

Mr. FLOOD. In this presentation by General White which you were talking about, will SAMOS be in that?

Mr. CHARYK. No; SAMOS will not be in that.

Mr. FLOOD. I do not know much about SAMOS. Do any of those present want to tell us about that? We have heard about it. I have not been so acquainted with Greek mythology in many, many years, but now we are dusting off all these names again. What about this lad?

Mr. CHARYK. I will be happy to make a short summary, and then if you desire to go into further detail, we can do so.

Mr. FLOOD. This is in the area of intelligence reconnaissance?

Mr. CHARYK. SAMOS is aimed primarily at the reconnaissance problem.

Mr. FLOOD. What I am not clear about is the polar orbit. What is the significance of the polar orbit insofar as SAMOS is concerned? What is the value or point of that?

Mr. CHARYK. The value of the polar orbit is so that reconnaissance is possible in those areas of the world in which we are most interested.

Mr. FLOOD. In which you are most interested. I had the impression that the purpose of the polar orbit was that you could get a look at more real estate.

Mr. CHARYK. No. It is a question of coverage of the areas in which we have greatest interest.

Mr. FLOOD. It is not just acreage?

Mr. CHARYK. In other words, if you were on an equatorial orbit, then your observations would be confined to that stretch of real estate in the vicinity of the Equator. With a polar orbit you cover another piece of real estate which is of considerably greater interest.

Mr. FLOOD. The Colonel seems to be champing at the bit back there. He wants to get in the act. He is a smart fellow. He didn't win those eagles in a poker game. Is there anything else that you would want to know if you were sitting here? What else would I want to know, in a paragraph or two.

Mr. CHARYK. Off the record.

Mr. FLOOD. How long will one of these birds live?

Colonel EVANS. The proposed operating lifetime——

Mr. FLOOD. Is this good?

Mr. CHARYK. We feel that reconnaissance is an area extremely important to us.

Mr. FLOOD. Yes, of course, but do you think this particular bird is good? Do you think you have something in this SAMOS?

Mr. CHARYK. We are very optimistic about the kind of data that can be achieved.

TRAINING

Mr. FLOOD. I had an impression which I mentioned to Mr. Mahon when we started the hearings. I wrote him a note. I write him all kinds of notes which he doesn't pay any attention to, and I don't, either, and we all forget about them.

As you know, the committee makes recommendations to the full committee for studies and surveys. I have the impression that in all branches of the service our training systems are obsolescent. We are projecting ourselves a generation, 10, 20, or 30 years ahead, with our weapons systems and our hardware and all these good things we are thinking about ahead. I have the impression, I have the visceral sensation that in all branches of the service there is no projection or thinking or planning ahead about training in all branches of the service. I don't know what I mean by "training." I am sure you people do. Whatever "training" is, I have the impression that there is no planning, no projection into this new era of training systems compatible with the whole rest of the show. I am afraid that 10 years from today, when all this long-haired "Buck Rogers" business is going on, our training systems will be as they were at Chickamauga or with the Rough Riders, or something like that.

Am I right about this? I would like to see a full committee staff survey made of the training systems of all branches of the service projected ahead 10 years.

Mr. CHARYK. I think there is the real problem that the technical sophistication of the equipment we shall be dealing with is such that the character and scope of the training will be far beyond things that we have been accustomed to in the past. So it will require not only a better qualified individual as a starting point, but a more intensive and broader training program.

Mr. FLOOD. Mr. Secretary, you have just restated the question. That is not an answer. I have commented upon occasion, at the Harvard Law School Dean Pound would ask me a question and I would take 30 minutes answering it and tell him all the law I knew. He would let me go until I ran out of steam and then would say, "Mr. Flood, you have just restated the question. What is the answer?" You and I agree. That is the premise. I have just stated the premise. Are you R. & D. people doing anything about that? Are you people supposed to do anything about it? I don't know. This isn't Air Force. I think everybody is in the same boat.

Mr. CHARYK. We have a rather severe problem, for example, in connection with the training of technicians for the ballistic missile program. This, I think, is exemplary of the kind of problems we shall have to deal with in the future. Part of our effort is going in the direction of training aids, in the development of simulators, so you can really get a true feel for the actual problem of operation of the complete system.

I would certainly agree with you, Mr. Flood, that I think further efforts here would be very fruitful.

Now perhaps General Wilson might add to that.

Mr. FLOOD. I shall suggest that there be a staff survey or a staff team, or whatever, go out and take a look at this whole problem for all branches in a formal way and bring back next year some substantial report on this problem of training of all branches, all categories, uniformed and civilian, in the next 10 or 15 years.

Mr. MAHON. Mr. Flood, I think that is a very good suggestion, and I see no reason why we should not do it. There was a time that training was not anything like so significant and complex as it is now. We certainly need to be alert to this very special problem which is becoming increasingly difficult with the passing months.

Mr. FLOOD. Did you want to add something, General Wilson?

General WILSON. I would like to comment on this.

We are doing something about the problem. As a matter of fact, we are very much aware of it. We are not doing enough about it. We have introduced this sort of education into the Air Force Academy. There are problems that we did not even recognize a few years ago. For instance, how does a man communicate with a machine? This sort of thing is now being introduced as education.

Our contractors in developing the processes for firing missiles and maintaining missiles have a most important part of that problem devoted to the training material now going into our depots and into our training commands.

Mr. FLOOD. On this question of missiles, do you want to add something?

General WILSON. This will, of course, be extended into the satellites. I would be the first to admit, sir, that we have not gone far enough. This really is not primarily the job of R. & D., but we have

a very great interest in it, as you indicated. It even goes so far now as to our officer and airman procurement, because we shall require a different type of education, perhaps.

Mr. FLOOD. Obviously, if you are concerned about it, I am not talking through my hat. There is obviously a problem of some kind here.

General WILSON. There is a very real problem, and we would certainly welcome congressional interest.

Mr. FLOOD. We will try to help you with a committee staff report of some kind. Those things are usually very helpful to you fellows after they are done.

General WILSON. That is right.

Mr. FLOOD. You used the word "missiles" again, knowledge of missiles. Now that we have 2 or 3 generations of different kinds of missiles, little ones and big ones, what are your problems now in R. & D. insofar as the inventory of missiles, the storage of missiles, warehousing of missiles, inspection of missiles? We have now a whole new problem in all branches, but more particularly the Air Force. Are we giving any particular and special attention to this business? Now that we have them, what do we do with them? Is anybody taking a look at that?

General WILSON. Yes, indeed.

Mr. FLOOD. We knew what to do with French 75's and with rifles. There must be a whole new school of problems with these silly pigeons.

General WILSON. Yes, that is right, sir. As far as the maintenance, storage, support, supply for the missiles in hand——

Mr. FLOOD. I do not mean the operation and maintenance people. I mean in R. & D.

General WILSON. On the R. & D. side, our principal problem area now is reliability, simplicity, reduction of cost. So we are turning our attention now to these areas. We are beginning to get enough experience to know what is causing us trouble and what is costing us dollars. So we can look forward to a whole new series of investigations into this field. It is almost turning at right angles to the normal approach.

FLYING AIDS

Mr. FLOOD. That is what I meant.

Have you any specialists here on air bases? I am interested in the problem of the lighting of air bases, the different types and kinds of lighting, pilot's approaches, and this whole rigmarole of airstrips, air complexes. Does anybody here want to talk about that?

General FRIEDMAN. Sir, I think if you wanted to get into this——

Mr. FLOOD. There must be research and development going on in this whole broad, very important field. What are the pilots saying? What do the pilots think about these lighting systems? What do the pilots want? What do these air bases look like? Now that we have built them, are we in the wrong war with these things, or what?

Colonel HUNN. We have a project called TRACALS which is investigating this very thing, investigating the lighting systems on airfields.

Mr. FLOOD. The elimination of blind spots over water coming in. We hear about them more in the civilian areas, but they must be the same and even worse with you fellows.

Colonel HUNN. We are cooperating with the FAA in this particular area. We are trying to find out the best way of lighting our airfields, anything to make it easier and safer for the pilots to make their landings.

Mr. FLOOD. Does FAA pay any attention to you? Do they listen to you? Do they let you in the room? Will they talk to you?

Colonel HUNN. Yes, sir, we are planning in coordination with them in this particular area.

Mr. FLOOD. Would you say that there is a very serious, continuous R. & D. operation going on with the FAA people on this whole problem which I have just posed?

Colonel HUNN. My answer would be "Yes."

DISPERSAL OF CHAFF

Mr. FLOOD. All right.

We have never heard enough about dispersal of chaff. We heard about it 4 or 5 years ago, and that was the end of it. We have heard nothing about it really in the last 4 years, from anybody. What about all this chaff nonsense? Is it just something somebody thought up? Does it have value to deflect enemy intelligence?

General WILSON. This is getting into the operational side, but the quick answer is yes, we do use it and, yes, it is effective.

Mr. FLOOD. Then it is out of R. & D.?

General WILSON. It is out of R. & D., except efforts to improve processes and dispensing mechanisms. It is effective.

RADAR IN TRINIDAD

Mr. FLOOD. By the way, is that BMEWS system we have on Trinidad on the Chaguaramas base, or is that off the base on some other real estate on the island? A very important question.

General WILSON. It is on Navy property at the moment.

Mr. FLOOD. On the base?

General WILSON. On Trinidad.

Mr. CHARYK. It is adjacent to the naval base and actually part of the military installation. It is actually on top of the mountain there.

Mr. FLOOD. I am more or less a specialist in the Caribbean-Latin area. I know a lot of these so-called leaders particularly the Prime Minister of Trinidad, Juan Williams, who is a very unfriendly fellow. When I saw this reference to Trinidad, I thought, good heavens, he will be climbing over this one. He will get reelected on that one. Where is it?

General WILSON. It is up on the hill on the Navy base, but there is one area adjacent to that, which is affected by the radiation from this radar.

Mr. FLOOD. Has Williams been screaming about this one?

General WILSON. Yes, sir, he has indeed. There is another aspect I am sure you know about, Mr. Flood, since you are interested in this area. Dr. Williams apparently wants to take over that property to form some sort of Caribbean U.N. capital.

Mr. FLOOD. No, no. This new combination of Leeward Islands——

Mr. CHARYK. The British West Indies Federation.

Mr. FLOOD. From Jamaica down. He wants Trinidad to be the capital. He lost this deal. What he offers, free, is our great naval base. Here is a beautiful thing. He says, "Here, I have a capital for you." Of course, I have news for him. That is the problem. He is a dangerous fellow.

(Off the record.)

USES OF BERYLLIUM

Mr. FLOOD. I am asking all the research and development people every year about this. I am interested in your uses of beryllium by your research and development metal people. Are you continuing your research and development on beryllium for airframes, for structural work, as well as its properties for solid popellants? Is this beryllium research going on?

General WILSON. Yes, it is still going on, sir.

Mr. FLOOD. Are we getting any place at all? Are you getting any place on the low fracture point of beryllium? Will we get a breakthrough? Its low fracture point is apparently what is keeping it out of the structural inventory. What is the last word on that? You fellows started this 4 or 5 years ago.

General WILSON. That is right, sir.

Mr. MAHON. Why do you not amplify that for the record.

Mr. FLOOD. The same thing with cesium and rubidium for ionic propulsion in higher space areas. I would like to know what you are doing on that.

General WILSON. All right, sir.

Mr. CHARYK. I might comment on beryllium in respect to high energy solid propellants. Beryllium is one of the most attractive metal additives for increasing the specific impulse of solid propellants. On the other hand, it produces very toxic exhaust fumes. We have a program underway on a rather limited scale.

(The information is as follows:)

Although the Air Force has been working on beryllium for some time, the undesirable properties of this material have been numerous. Overcoming the brittleness has been one of the major ones but an aggressive program is now being carried out to improve the ductility. Some of the programs are: purification of beryllium to find out the exact strength in a pure state; combining it with other materials to produce alloys; and making composites to utilize the higher strength properties of other materials. Although it is not possible to predict when one of these explorations will result in a breakthrough, we believe that the ultimate potential properties of beryllium in alloy with materials for use in future structural shapes makes it imperative that this effort be continued.

Research on a 0.01 pound thrust engine which will use cesium as a propellant has recently been initiated by the Air Force. The engine can be used as a device for orienting a payload in space or correcting its orbit. This first engine will be an experimental model only.

Rubidium shows promise as a working fluid for turboelectric generating sets using a nuclear heat source for long duration, high power space systems. We are presently working on this project in the early research and study phase in an effort to find proper application and adaptability.

NUCLEAR PROPULSION FOR AIRCRAFT, SNOW REMOVAL, CONVERTIPLANES, AND GROUND EQUIPMENT

Mr. FLOOD. Tell us something about nuclear aircraft, when you get a chance, in the record. I shall ask these questions. We shall not

to go into them now. I want to know as much as you can about nuclear propulsion for your aircraft.

do not understand this business of dispersed fighterbombers. That erminology baffles me. We have taken the term, the humanities, and prostituted it completely as we do here. The word "humanities" now has lost all context to what it means in semantics. Will you develop something about what we now call the humanities, how it applies to troops, all the things you are doing about troops, psychologically, neuropsychiatric tests for space, and whatever else you are doing, as well as what you call—it is a wonderful phrase—biologistical problems and biomechanical problems.

General WILSON. Aviation medicine, sir.

Mr. FLOOD. These fascinating things. I am sure you don't know what they mean, but they sound good.

A very proximate problem: What are you doing in research and development about removal of snow from airstrips and icing on airstrips? I had a bad night last night with snow and ice on airstrips. All I see is what I saw on airstrips in World War II, the same equipment.

I want to know a great deal about the convertiplanes, the short takeoff planes.

What research and development are you doing, research and development only, on airlift? I am not interested in what kind of planes you are doing research and development on, but what is the Air Force doing in its research and development vis-a-vis the problem of airlift, not aircraft, which is something else. There must be a million problems about an airlift for the Air Force other than aircraft. What are they? What are you doing about them? I don't know.

When you talk about the snow removal and ice removal, then develop the whole problem. Is there a new generation of ground equipment for the Air Force? Much of the Air Force is on the ground. Thousands of men work on the ground in the Air Force. What do they work with? Who designs it? Who does the engineering? What do the next 15 or 20 years show us on ground hardware for the Air Force? What are you thinking about? Will it be jeeps, or what?

That is all, Mr. Chairman.

(The information requested may be found in the appendix on page 512.)

Mr. MAHON. Mr. Ford.

DYNASOAR PROGRAM

Mr. FORD. Last year, General Wilson, we discussed to some extent the DYNASOAR program and you described it, according to the testimony, as an exploratory effort. The program called in the justifications last year for an obligation of about $35 million. This year the request is for $50 million. Is the program more now than an exploratory effort?

General WILSON. No, I would say it is still an exploratory effort. We consider this one of the most important projects we have in the Air Force, because we feel if there is ever to be space flight, this will be a basic contribution to it. This will give the man the opportunity to take off from a given point and return to a given point.

We also realize that as time goes on this will be an extremely costly program. Therefore, we had better be right at the start. Normally our programs are divided into three phases, 1, 2, and 3. In this instance we have established a prephase 1 or a phase Alpha, as we call it, which is to help us assure ourselves that we start out properly. So, in fact, this is an exploratory program.

We have gone so far as to select a contractor for a glider. We are about to select an associate contractor for the booster, and we are about to establish a system of subcontractors to support the whole program. The management system is being established at Wright Field.

So we have gone this far, and we would hope presently to embark on a series of unmanned launchings and hope that this would soon develop into a series of manned launchings.

Mr. FORD. Is your program for fiscal 1960 being executed on the basis of $35 million which was requested at the time the fiscal 1960 budget was presented?

Mr. MEYER. At the present time the $35 million is programed but only a portion has been used for this phase A study. When the phase Alpha study is completed, probably in April, then if there is a selection made and a decision to go on to the next phase, that portion of the $35 million which is still not on contract will be utilized.

Mr. FORD. Is the request for $50 million in fiscal 1961 firm or does it depend upon this decision which will be made in May?

Mr. MEYER. It will depend upon the decision made in May with funds going on contract in June or July for the continuing portion of fiscal year 1960 funding, and then 1961 funds coming in at a later point in time.

It is a phased program, as General Wilson said, and the funds are in here to support the program.

Mr. CHARYK. As has been said, it is our best judgment at the present time, as to the character of the program. We will not be able to really definitize the situation until we have the results of the phase Alpha study.

Mr. MEYER. I might make one comment. This, in part, is the philosophy of having unobligated balances being obligated early in the next fiscal year. A portion of this $35 million could be in that category which would not be contracted until the first quarter of 1961.

Mr. FORD. It would be committed as we use the term, but not obligated?

Mr. MEYER. Yes, sir; committed to the program.

Mr. FORD. What is the anticipated total cost of the program? I know there has been a statement made that it is a very large program if you go into it in a substantial way, but I think it would be helpful for the record if you could give us any reasonable figure so that we could look at the total program over a period of time.

General FRIEDMAN. Through 1966, as we see it now, it will be on the order of about $638 million. Of course, here we are not talking about a complete operational system. I am talking about R. & D. vehicles and tests and evaluation through the period. If everything broke through as we would hope it would on the basis of the phasing

of the research and development to the extent of this $638 million, we would start putting some procurement moneys on that and, again, hoping everything would come along per schedule, we could be talking about another $300 million through 1965 In other words, about $800 million. That is what we would call an "objectives" plan. We are not currently considering applying amounts of this order. That is the kind of cost you would have to consider as you go down the road.

Mr. FORD. None of those figures you have used really involves an operation capability with the weapons system?

General FRIEDMAN. Leading toward it, though.

Mr. FORD. I suppose you could not give us any kind of a figure that would involve the cost of an operational weapons system at this point?

General WILSON. No, sir; this is one of the reasons we established this new area of advanced development. We do not know what this will lead into. This is not aimed specifically at a weapons system at this time.

NUCLEAR AIRCRAFT PROGRAM

Mr. FORD. Last year, General Wilson, we discussed the nuclear aircraft program. As I read the testimony, the total amount in new obligational authority, combining Air Force and the AEC, was around $150 million of which the Air Force would have approximately $75 million.

Has the Air Force utilized that $75 million for this program?

General WILSON. Yes; $59.3 million of the $75 million so far.

Mr. FORD. Do you expect to obligate the remainder before the end of the fiscal year?

General WILSON. No, sir. This program has changed somewhat in character and the emphasis has shifted from an almost total preoccupation with the direct cycle to an emphasis on an indirect cycle. The new requirement for fiscal year 1960 is $59.3 million. The remaining $15.7 million has been reprogramed to other projects and has been reported to the Congress.

Mr. FORD. Last year you seemed to indicate in your testimony that although you supported the amount involved, you did not agree with the direction in which the program was going. I gathered from your testimony that you thought we ought to go to a prototype, fly something, rather than to concentrate on nuclear-powered aircraft that would have a weapons system capability.

How do you feel about that?

General WILSON. I must confess that I have had a change of heart. I still would like to see an early flight, but I have come to realize that this thing has cost almost as much money to do as we would have had to spend on something that would be more useful.

If you ask me the same question today, I would have to say that I would prefer now to take a little bit of a delay to come up with a more useful airplane. I think I am also saying that we missed our chance and this, in part, accounts for my change in thinking. I think if we had concentrated early on this direct cycle, we would have had an airplane that could have flown on nuclear power, probably not a very good airplane, but we could have done it. However, in taking

a second look at our program, the time has gone by and it is quite probable now that it will take just as long to produce a useful airplane as it would to produce just an early flight one.

Mr. FORD. I gathered the impression that there is a greater degree of unanimity that this program we now have is the right program. There does not seem to be the division between a program for a prototype with no weapons capability, and the alternative, a nuclear-powered aircraft with a real weapons system capability; is that right?

General WILSON. There is a very much greater degree of unanimity in the Department of Defense, the Air Force, and the AEC side.

USE OF FOREIGN CURRENCIES IN OVERSEA RESEARCH PROGRAM

Mr. FORD. Last year we discussed the ARDC's oversea research program. I think the amount involved was around $7 million. I raised the question whether some of this could not be funded by utilization of counterpart funds or foreign currencies. A response was given to the committee and, frankly, I cannot recall exactly what the conclusion was, but can you, first, tell us how much you anticipate spending in fiscal 1961 in that area?

Secondly, whether you can utilize counterpart funds or comparable foreign currency?

General FRIEDMAN. The figure through June 30, 1960, is on the order of about $851,000. That is, payments in foreign currencies for the purposes which you are addressing yourself to, Mr. Ford.

I think that perhaps this is a disappointing figure in that it is perhaps lower than you might have supposed, but the basic problem is having the capability in the proper places where the foreign currencies are available to us. I think General Wilson could speak to that phase of it.

General WILSON. We have discussed this with the Department of Defense who have assured us that we could not use counterpart funds properly in this area because of the legalities and because of the places we want to spend the moneys. So, if we are to support the effort, we must do it out of our own resources.

Mr. FORD. What was the figure you gave me?

General FRIEDMAN. $851,000.

Mr. FORD. Out of the total of how much?

General FRIEDMAN. $3 million.

Mr. FORD. The total amount that you anticipated to be spent overseas in fiscal year 1960 was $6,996,000.

Do you expect to spend that much in fiscal 1960?

General FRIEDMAN. The figure you gave was obligations; the figure I gave you are actual expenditures, actual and estimated.

Mr. FORD. In this kind of work, your obligations and expenditures would be nearly the same. This is for personal services; this is not for construction. This is not for long leadtime items.

Mr. MEYER. That is right, but the contracts are not all let on the first day of the fiscal year. These contracts are let through the fiscal year, which makes for a lower expenditure rate than if we went out simultaneously on July 1. Then you would have 70 to 75 percent expenditure rate. Some of these contracts could be let in the last month

of the fiscal year. It is a continuing process in the overseas office of putting out these contracts to foreign scientists.

The expenditure rate cannot be applied in this case.

Mr. FORD. Every time the Congress tries to find a way to spend legitimately counterpart funds for programs that make sense, we run into a large number of objections, restrictions, and complications. This is not the only case.

I would like to find a way by which we can utilize those funds for the Air Force or any other one of the services that want to use these funds for research and development.

Can we get from the Air Force or the Department of Defense such language that we can include in the appropriation bill which would free these funds for this purpose?

Mr. CHARYK. We can certainly look into that, Mr. Ford. I think that one of the problems has been highlighted by General Friedman in that the countries in which counterpart funds are, by and large, available, are not those countries in which the research scientists are located with whom we primarily deal.

On the other hand, I am sure that there are cases where there is a match between the capability and the counterpart funds, but I do not think we have a breakout on that.

Mr. FORD. As I look at the list of countries which were set forth on page 200 of the hearings last year, it is my recollection that those countries, or at least a share of them, have a substantial amount of counterpart funds available.

As I say, and as I have said before in other subcommittees, we get more alibis, more excuses, as to why these funds cannot be used. I do not think those alibis and excuses come from the Air Force. They come from some other area.

General FRIEDMAN. I would just like to state that, from my own standpoint, as a budget officer, I certainly support your objective here, and so long as we get the work done, I would much prefer to use other funds rather than Air Force funds.

Mr. FORD. Rather than U.S. dollars?

General FRIEDMAN. Rather than U.S. dollars.

Of course, I think you are well aware of the balance-of-payments problem and it may well be at this time, Mr. Ford, that some urging on the part of this committee might result in more favorable consideration of the problem than heretofore. I would like to suggest, sir, that rather than make this a unilateral service consideration—and we certainly will bring it up with the Department of Defense and others involved—at least have the Department of Defense give you a report as regards what they can do and with whom the committee might seek a more final solution than certainly we could on a unilateral basis.

Mr. FORD. I would like to have, Mr. Chairman, the Defense Department give us any language which we can include in this appropriations bill which would be helpful in breaking this log jam.

Mr. MAHON. I will ask the staff to prepare a letter for me to send to Secretary Gates in behalf of the committee urging that something effective be done to meet this situation which has been discussed here.

Mr. FORD. It is a relatively small amount but it is a way in which we could be helpful both as to dollars and the utilization of these blocked amounts of money.

Colonel HARRISON. To amplify what you have said, in the "Construction" appropriations this year you will see new language. In fact, there is a separate appropriation for each one of the services called special foreign currency programs wherein the Congress has been asked to appropriate dollars, the dollars will then be paid to the Treasury for foreign currencies to be made available to Defense. In this way they feel we can implement and expedite this type of program you are talking about. This pertains only to the "Construction" appropriations, however.

Mr. LAIRD. It is true of every budget, not only of Defense. It is true of HEW and Labor. It is in every budget bill this year.

Colonel HARRISON. Yes, sir. This is a Bureau of the Budget directed program and they are trying to apply it across the board.

Mr. LAIRD. Why not here?

Colonel HARRISON. I cannot answer that, sir, unless the fact that it was an oversight or that the amount was considered insignificant. I do not know the answer but I will get it for the record.

Mr. LAIRD. The amount cannot be considered too insignificant because you have a special line item in the Labor Department Budget for about $32,000.

Mr. FORD. If that language would be helpful in this bill, I think we ought to get it in because it is $6 million or thereabouts.

Colonel HARRISON. Yes, sir.

(The requested information follows:)

At the time of the formulation of the fiscal year 1961 budget it did not appear that there would be sufficient opportunity to utilize available foreign currencies in the research and development areas. The currencies then available were not generally susceptible for use in this program.

Mr. FORD. What do you expect to have for this program in fiscal 1961?

Colonel HUNN. About $3.5 million in contracts overseas.

Mr. FORD. That is quite a drop from your $7 million program in fiscal 1960. What caused that?

Colonel HUNN. I really cannot answer the question as to what caused it. I recently checked the number and this is the number I got. There will be about $177,000 that will go to pay for the people who are operating the European office, civilians and military that are assigned. This will be in addition to the $3.5 million for contract services.

FISCAL YEAR 1960 OBLIGATIONS

Mr. FORD. General Friedman, as you know, I am also interested in what is proposed to us in a budget at the time you come up here and what the execution is. Last year for fiscal 1960 budget the total direct obligations for R. & D., it was anticipated that you would have $1,102,100,000, and according to the green sheets before us now this is limited to fiscal year 1960 and you show the figure of $1,526,674,649.

There is a difference between what you submitted last year for fiscal 1960 and what you now are showing you are executing in the amount of $424 million.

What is the explanation of the difference?

General FRIEDMAN. It is in this instance, as in other appropriations, a requirement on our part to make adjustments in our 1960

program. In order to aline ourselves to the fiscal year 1961 outlook, there have been amounts which we had previously intended to commit which we have not committed and which are being carried over to finance fiscal year 1961 program. As I indicated previously, there has been some delay in getting programs under way. The combination of the two——

Mr. FORD. I am not sure that I understand your answer in relation to the figures I have before me. I am referring to the fiscal year 1960 program.

General FRIEDMAN. Yes, sir.

Mr. FORD. In the budget justifications last year you showed $1.1 billion direct obligational program and now you are showing for fiscal 1960, $1.5 billion total direct obligational program. That would lead me to believe your program is bigger, not smaller.

General FRIEDMAN. Part of that is the space transfer. Part of that would be the transfers from the emergency fund.

In other words, what I am saying here, or what I said, is that on a comparable basis, program by program, this would be true. I think in the space program we are talking about $256 million as a specific example and $15.3 million, in emergency fund transfers.

What I am saying is that there is really a net effect.

Mr. FORD. Roughly, the same situation prevails in the case of total obligations. I will not read the figures but the difference between what you proposed and what you are asking is around $485 million. If you take the case of new obligational authority, the difference between what you have proposed and what you are showing now is a plus $266 million. In all three instances, from what you submitted and what you are planning to execute, there is a substantial increase.

General FRIEDMAN. That is right.

Mr. FORD. I think we ought to have the benefit of an explanation on this.

General FRIEDMAN. Speaking to the new obligational authority, the amounts appropriated cannot change because that is established by legal limits. I believe the item to which you refer there would be "Appropriation adjusted." It would be adjusted by the amount of the transfer. In other words, what we call a comparative transfer.

If you will look below in the financing section of the green sheet, you will see the comparative transfers and the handling of the unobligated balances from previous years. This then brings you down to what is called the new obligating authority. In other words, your appropriation is $1,159,900,000 and if you take into account the appropriation transfer of $256,250,000 which is shown, this would give you the increase to what we call new obligational authority adjusted of $1,416,-150,000.

Mr. FORD. What I would like to have you do is to take the figures in each instance as they were submitted last year on pages 136, 137, and 138, part 6, of the hearings and the figures as they are reflected in the green sheets for the presentation this year and explain or reconcile the differences.

They are substantial and I think the committee should have the benefit of such an explanation.

General FRIEDMAN. Yes, sir. We will be happy to provide that.

(The information follows:)

The differences between the fiscal year 1960 estimated obligations of $1,115,900,000 as submitted to the Congress last year and the $1,601,824,649 as reflected in the fiscal year 1960 column of the fiscal year 1961 green sheets are reconciled as follows:

Fiscal year 1960 estimated obligations reflected in the fiscal year 1960 budget estimate	$1,115,900,000
Comparative transfers from other accounts	158,348,158
Increase in unobligated balance brought forward	30,532,491
Unobligated balance transferred from "Aircraft, missiles and related procurement," Air Force appropriation	1,875,000
Congressional add-on to accelerate MINUTEMAN development	10,000,000
Transfer of space program from Advanced Research Projects Agency	275,250,000
Increase in reimbursable obligations	61,350,000
Increase in unobligated balance carried forward	−51,431,000
Fiscal year 1960 estimated obligations as reflected in the fiscal year 1961 green sheets	1,601,824,649

Explanation of the differences noted above follows:

Comparative transfers from other accounts.—This represents the estimated obligations to be incurred during fiscal year 1960 against the amounts appropriated in fiscal year 1959 under other Air Force and ARPA appropriations for functions and programs which are included in the Air Force research, development, test, and evaluation estimate for fiscal year 1961. These amounts were not reflected in the obligations as shown in the budget estimate submitted to the Congress for fiscal year 1960, since such functions and programs were identified with the aforementioned other appropriations at that time. Examples of these are the space programs, responsibility for which has been transferred to the Air Force from the Advanced Research Projects Agency, and the support of the Headquarters, Air Research and Development Command.

Increase in unobligated balance brought forward.—This increase results from the actual unobligated balance being greater than the amount estimated as reflected in the fiscal year 1960 budget estimate. This increase is attributable primarily to (a) the receipt of $15,330,000 of OSD emergency funds at the end of fiscal year 1959 which could not be obligated until fiscal year 1960; and (b) the withholding from apportionment of $15 million by the Bureau of the Budget, which therefore was not available for obligation during fiscal year 1959.

Unobligated balance transferred from "Aircraft, missiles, and related procurement," Air Force Appropriation.—This represents funds transferred to support Air Technical Intelligence Center requirements determined to be appropriate under the research, development, test, and evaluation program for fiscal year 1960. This transfer was not known at the time the fiscal year 1960 budget was submitted to the Congress.

Congressional add-on to accelerate MINUTEMAN development.—This represents the additional amount appropriated by the Congress for the MINUTEMAN program. These funds were therefore not included in the budget as submitted for fiscal year 1960.

Transfer of space program from Advanced Research Projects Agency.—These funds were transferred during fiscal year 1960 and therefore were not included in the budget submitted to the Congress last year. The transfer of funds coincides with the transfer of responsibility for the SAMOS, MIDAS, and DISCOVERER space programs from the Advanced Research Projects Agency to the Air Force.

Increase in reimbursable obligations.—This primarily reflects the addition of reimbursements for orders received or expected from the National Aeronautics and Space Administration amounting to $40 million. It also provides for the cost of operation and management of the Headquarters, Air Research and Development Command for which funds were appropriated in fiscal year 1960 under the Air Force "Operation and maintenance" appropriation. This activity is included in the fiscal year 1961 budget under the Air Force "Research, development, test, and evaluation" appropriation.

Increase in unobligated balance carried forward.—This increase is associated primarily with the reservation of $59 million in the fiscal year 1960 program to be carried forward to support the program for fiscal year 1961.

INCREASE IN OBLIGATIONS FOR MILITARY ASTRONAUTICS

Mr. FORD. I think if you turn to the first white sheet, page 4, you will find under "Military Astronautics and related equipment," a program for fiscal year 1960 in the amount of $278 million. If you look at the justifications in the hearings last year, it shows that in this category you were planning for a budget program of $2,150,000.

General FRIEDMAN. That is right. This is the $256 million comparative transfer and we counted in here the change for the financing of the headquarters. That would be another thing.

Mr. FORD. I think for the benefit of the record we should have a more definitive explanation. I think the one that has been discussed here is the general basis upon which the changes were made, but there are substantial differences that ought to be in the record for explanation.

General FRIEDMAN. We can do that.

I am sorry I could not go down, item by item, now, but we will be happy to provide it for the record.

(The information follows:)

The military astronautics and related equipment program included in the budget estimate submitted to the Congress in fiscal year 1960 amounted to $2,150,000. This has been increased to $278,879,000 in the fiscal year 1960 column of the estimate for fiscal year 1961.

The increase of $276,729,000 is comprised of: (a) $275,250,000 transferred during fiscal year 1960 from the Advanced Research Projects Agency concurrent with the transfer of responsibility for space programs to the Air Force; and (b) $1,479,000 representing the net effect of numerous program changes which have occurred since the beginning of the fiscal year. The space program includes the following:

SAMOS	$160,000,000
MIDAS	31,300,000
DISCOVERER	83,950,000
Total	275,250,000

LANGUAGE PERMITTING MERGERS OF ACCOUNTS

Mr. FORD. In the language last year of this account we put in a proviso permitting mergers of accounts to get us straightened out with the new definition of research and development.

Why do you need that language again in fiscal 1961?

Mr. MEYER. The language in 1961 is still needed, based on the fact that we still have amounts in the separately identified R.D.T. & E. accounts of the procurement appropriations which may, upon determination of the Secretary of Defense, be transferred to the R.D.T. & E. accounts of the DOD.

This is a part of the emergency fund provision transfer authority which Congress gives the OSD.

Mr. FORD. I do not think this language was included for the emergency fund program. This was only, as I recall, for the purpose of permitting consolidation with the redefinition of research and development.

General FRIEDMAN. Yes, sir.

Mr. FORD. Let us not keep this as a perpetual thing. This was for a specific purpose but when is that purpose going to end?

Mr. MEYER. As General Friedman and General Wilson pointed out, this is for the purpose, as you say, of taking it out of the procurement D.T. & E. and putting it into R.D.T. & E. We have started several things like the B–70 and other things in the procurement account which we are keeping separately identified. I think the purpose of this language is ended and at such time as an affirmative decision is made, that no new things will be started in the procurement account separately identified; General Friedman gave the Air Staff position on this.

Mr. FLOOD. You have a billion dollars in there hanging on that hook?

Mr. MEYER. Yes, sir; but most of it is identified with the ATLAS, TITAN, and MINUTEMAN.

Mr. FLOOD. Then the answer to Mr. Ford's question is that it will take you 3 or 4 years before you get that language out of the way, the way you are going?

Mr. MEYER. It could be, sir.

Mr. FORD. You want it out of the way, or is this going to be used as a device? I agree with the change of definition and I think it is good, but when we accomplish that, let us not just keep this language for convenience.

General FRIEDMAN. It is not for convenience specifically. When the three new appropriations were established, as opposed to the previous two, it was our opinion—and the Secretary of Defense agreed—that the language should be permissive, recognizing that there are always changes in prior year accounts which would make funds available and which we would normally report to the committee as recoupments. So long as the language was permissive, this would preclude some rather difficult problems if we had to follow through on these accounts clear through to the total expenditure of the moneys.

It represented a very serious accounting problem. I will agree that we get a certain amount of flexibility by virtue of the permissive language. However, this does not give us an opportunity to go off willy-nilly and do as we please because, under the guidelines established by the committee in the reprograming report, we would be required to bring that to the attention of the committee. It is not as loose as it might appear on the surface at all.

Mr. FORD. It might be necessary for this year or 2 more?

General FRIEDMAN. I would say that as far as——

Mr. FORD. I certainly do not think it is a requirement in perpetuity.

General FRIEDMAN. As far as the R.D.T. & E. appropriation is concerned, I could see somewhere, within maybe 2, 3 years. Insofar as the new procurement appropriations are concerned, I would like to see the language remain permissive until the prior year appropriations—the old accounts—are completely liquidated.

Mr. FLOOD. Will you permit me to ask this?

Mr. FORD. Go ahead.

R.D.T. & E. FUNDS REMAINING IN PROCUREMENT ACCOUNTS

Mr. FLOOD. Mr. Mahon asked General Wilson a question and General Friendman: What was the amount that the Air Force still had of procurement which belonged over in research and development?

You told him in the neighborhood of a billion dollars. Nobody explained if the Army and the Navy cleaned their houses up, why the Air Force still is in procurement with a billion dollars? Why is your problem different than the Army and Navy? They did what they were told and you did not.

Why?

General FRIEDMAN. I would think a portion of it would be the organization of the procurement and the research and development setup within the services. I would say that a very significant element would be the kind of project we are talking about, the status of the programs—where they stand—as between development and procurement.

Mr. FLOOD. Would not all of those elements be present in any research and development program? Where are the problems in research and development peculiar to the Air Force that would not also exist in research and development for the Navy, Army, and Marines? Why are your problems special?

General FRIEDMAN. I do not know that I am saying they are special, Mr. Flood. The billion dollars we are talking about pertain to programs that are already carried within the procurement appropriations. They have been started, are underway. We see no particular advantage to making a change in the appropriations.

Mr. FLOOD. General, that is the point I make. We were not interested in what you thought, or what advantage you saw. This is what the Congress ordered be done, and the Air Force traditionally just pays no attention to it until you are ready.

Mr. MEYER. If I may, sir, $921 million of this $1 billion we are discussing is tied to the ATLAS, TITAN, and MINUTEMAN programs. These programs were started a few years ago.

Mr. FLOOD. My friend, we know that.

Mr. MEYER. The concurrency that Dr. Charyk talked about which we needed in these high-priority programs has gotten the research and development and the procurement so intermingled now that to bring it back into the research, development, test, and evaluation program would be fictitious.

Mr. MAHON. If I may interrupt, that is all interesting and understandable, but do you feel that anything requires us to do this in 1 year, or do you have time to do it? No. 2, do the Navy and Army to some extent have the same problem, and are they proceeding along the same pattern?

Can you answer those two questions?

Mr. MEYER. The Army and the Navy had much greater problems, sir, though they did not have these large concurrent programs going at the time this directive came out. It was very easy for them to make all their starts in the research, development, test, and evaluation. We were caught with ATLAS, TITAN, and MINUTEMAN, and ATLAS started in 1955, TITAN along thereabouts, and MINUTEMAN a little later.

Mr. MAHON. Is there any requirement at all that makes it mandatory you make this change immediately or what is the background?

Mr. MEYER. No, sir. We are working very closely with the Department of Defense and they have acknowledged that these things we

are discussing here, ballistic missiles, should stay in the separately identified part of the procurement account.

Mr. MAHON. Is that in conflict with any law or regulation?

Mr. MEYER. No, sir. The legal appropriation language in both appropriations allows it.

Mr. MAHON. Mr. Ford?

USE OF EXISTING FACILITIES

Mr. FORD. There is one final proviso in this section of the proposed law and we all know why it was included. It is a very innocuous bit of language but I gather it has not hamstrung the Air Force in its implementation of its program.

General FRIEDMAN. No, sir. It has not, due largely to the fact that this committee did assist in changing the language from that initially proposed to where it is workable. However, I would like to indicate that we certainly examine existing facilities in all instances before we proceed to open a new facility. Therefore, we feel that the intent is met and the need for the change in terms of legal language, I mean the need for the——

Mr. FORD. You really do not need the language to carry out the policy you told us you were following anyhow?

General FRIEDMAN. I agree, sir.

Mr. FORD. If that is the case, why is this requested for inclusion in th bill for 1961?

General FRIEDMAN. Off the record.

Mr. FORD. That is all.

Mr. MAHON. Gentlemen, we will reconvene at 2 o'clock.

Thank you very much.

AFTERNOON SESSION

Mr. MAHON. We will resume our hearing.

VALUE OF BASIC RESEARCH

Mr. Lipscomb, do you have some questions?

Mr. LIPSCOMB. Mr. Secretary, in your opening statement you made a statement as to the necessity for putting vigor into our basic scientific program, and you made a point of the fact if this is neglected no amount of dollars in later years can eliminate the deficiencies.

Then you went on to say that in your opinion we have had too many examples of false economy in the past and you think it is incumbent to our future security that they are not repeated.

What did you have in mind in regard to a "false economy", and also can you give us some idea of what has been, or is being, done so that this situation will not be repeated?

Mr. CHARYK. Well, I think that not too many years ago there was an attitude on the part of certain individuals to question the value of basic research in the Department of Defense. At that time certain cuts were made in regard to the support of basic research programs.

Since that time I think we have seen a general increasing trend in the support of basic research.

I think the most important feature is to eliminate fluctuation; namely, to insure that there exists a rather steady support for basic research.

Actually, in the case of the Air Force we have tried to build into the research, development, test and evaluation program a plan to gradually augment the support over the next few years.

Mr. LIPSCOMB. Are you saying you feel the situation is such now that we are keeping a steady flow of finances going into basic research at an adequate level?

Mr. CHARYK. I think we should try to increase the level of support in a steady fashion. I do not believe that basic research is an area that responds to rapid fluctuations. I do not think that it would be very wise, for example, to substantially increase the support in any one year. I think what is required here is a gradual increase in the level of support.

General WILSON. May I make a comment on that area?

There was a time when the research and development activities came under the material part of the Air Force and our efforts were confined almost entirely to improving what we already had on hand. Under this system, the atomic bomb, for instance, could never have been invented. It was a matter of just creeping along bit by bit.

It was this unfortunate situation that really resulted in the formation of ARDC. We had a group of scientific people study our problem and they saw we would never make progress unless we established an organization separate from the construction side of the game. It was at that time that we started really supporting basic research as a pool of knowledge from which to draw new ideas and new devices.

Mr. LIPSCOMB. This statement that the Secretary made to which I referred with regard to false economy refers back several years?

Mr. CHARYK. A good many years.

Mr. LIPSCOMB. On the other side of the picture from time to time I have had the impression there has been poor programs initiated which means we lose time, waste manpower, and waste money, too. Now, have we a program, an adequate program, that can assure us—as much as possible in basic research—we do not get into poor programs, or do poor programing?

Mr. CHARYK. I think adequate support of the research effort is the best guarantee that proper and timely technical decisions will be made in the very large weapon systems development programs where an error in judgment, or a lack of technical information, can cause the expenditure of large amounts of dollars for no effective purpose.

Mr. LIPSCOMB. Is there the danger if we allocate, or appropriate, too much money the programs will be developed in a fashion that would allow poor programing?

Mr. CHARYK. If there were unlimited funds, I am sure we would have major technical expenditures in programs without an adequate technical base and there would, as a result, be considerable waste and inefficiency.

I attempted to address myself to this particular problem in my statement when I referred to the two limits, the minimal risk approach on the one hand and the full application of the concurrency principle on the other hand. I pointed out if we did everything on

the basis of the full application of the concurrency principle inevitably there would be a large waste and duplication and inefficiency, but that, in certain special cases it is a very good thing to do as in the case of the ballistic missile program.

X–15 PROGRAM

Mr. LIPSCOMB. I believe in the budget before us there is, roughly, $10.9 million in added costs for an engine for the X–15. Is that correct?

Mr. CHARYK. I do not believe the figure is correct.

Mr. LIPSCOMB. How much have we invested in the X–15 program to date?

Mr. CHARYK. I think the total expenditure through the fiscal year 1961 would be of the order of $140 million.

Mr. LIPSCOMB. Does that include the amount in this budget before us?

Mr. CHARYK. That is correct.

Mr. LIPSCOMB. I read in this morning's paper that the X–15 yesterday performed very satisfactorily.

Mr. CHARYK. It was a very successful flight. As a matter of fact, we have had only one flight in which there was serious difficulty.

Mr. LIPSCOMB. According to the news report this morning, there is expected to be six more flights and then the X–15 will be turned over to NASA.

Mr. CHARYK. Actually, there are three aircraft. Two of them are equipped with the early engine which we call the XLR–11, and on one of the aircraft we have had five successful flights and on the other aircraft, one demonstration acceptance flight, and the next flight with this aircraft will be with a NASA pilot at the controls.

The third aircraft is being outfitted with the advanced engine which we call the XLR–99.

There will probably be three flights with this engine before it is turned over to the Air Force.

Mr. LIPSCOMB. Does the money in this present budget complete the funding of the X–15 for the Air Force?

Mr. CHARYK. No. There would be additional funds in subsequent years, depending on the total scope of the program. The amount might vary, I would estimate, between $25 million and $40 million.

Mr. LIPSCOMB. When will NASA begin taking over the financial arrangements of the X–15?

Mr. CHARYK. Actually, practically all of the financing so far has been by the Air Force with a small contribution from the Navy. NASA will provide services, pilots, and so forth, but they are not involved in the actual funding of the development program itself.

Mr. LIPSCOMB. None of the X–15 money shows up in the NASA budget?

Mr. CHARYK. That is correct.

Mr. LIPSCOMB. And yet during this fiscal year you will probably turn this over to NASA, or turn a portion over to NASA?

Mr. CHARYK. The flight test program will actually be conducted by NASA pilots and by Air Force pilots. It will be a joint test activity.

The support from NASA will, of course, appear in their O. & M. account, but there are no dollars in the development part of the program per se.

SNOW REMOVAL EQUIPMENT

Mr. LIPSCOMB. This morning Mr. Flood asked you to submit answers to his question in regard to snow removal. I believe in your budget you have a request for an "ice jet" snow and ice removal vehicle. What brings about the necessity for an ice jet snow removal vehicle, and the research and development done by the Air Force?

General DEMLER. We had planned this winter to test a version of a jet engine, if you will, facing forward and in its operation would not only melt the ice and the snow on the runways, but because of the large amounts of heat involved, actually evaporate the ice and snow. As you know, most of our runway removal equipment is blowers and scrapers. This is a research and development test program. We will not be able to finish the equipment so as to test it this winter and it is my understanding this will continue next winter.

Mr. LIPSCOMB. I believe there is $200,000 in this budget for this purpose?

General DEMLER. It is a fairly small amount.

Mr. LIPSCOMB. What is the total research and development money for the jet snow and ice removal vehicle?

General DEMLER. I will try to find that out for you.

Mr. LIPSCOMB. Is the Air Force now doing the research and development on this vehicle, or do they contract this out to private enterprise?

General DEMLER. It is done through a contractor; yes.

Mr. LIPSCOMB. When such a vehicle is developed will it be sold commercially? Can that be done after the Air Force pays for the research and development?

Mr. CHARYK. Actually the information in the development portion of the program would be available to all interested parties, and in the event we were procuring items of this type, the various interested companies would have an opportunity to bid, having available the information that was developed during the research and development program.

Mr. LIPSCOMB. Why is it not practical to just put out the word to all manufacturers of this kind of equipment that you need a jet ice and snow removal item and let them go ahead and develop it and get it ready without the Air Force putting in their time and effort and money in the development?

Mr. CHARYK. I am not too familiar with the details of this particular program, but I assume that the attempt here is to develop equipment that will do the job in a fashion that is superior to existing equipment, and the modifications are of such a scope that the various companies would be reluctant to spend the necessary dollars out of their own resources to exploit the possibilities.

Mr. LIPSCOMB. Here is a research and development job of a vehicle that would be of great benefit to many areas. Snow removal is a problem not only of the military but of many civilian areas.

Mr. MAHON. What about highways, within a certain limit?

Mr. LIPSCOMB. And highways. This is an area that manufacturers of this kind of equipment should go into if there is a market. This

would be an opportunity to expand their business and their capability. Here is an item that I happen to think we are putting military manpower on when we should be concentrating their efforts on a real military need, and perhaps this is an area where we are wasting good manpower and money.

Colonel DICKSON. We have a validated requirement to clear 10,000 feet of runway 300 feet wide in half an hour. This is in support of the Strategic Air Command so we can keep their bases clear for all-winter operations, particularly in the north. It is also applicable to the Air Defense Command so we can scramble the fighters. Now, it is a very difficult job to get snow removal equipment that can do this. There are a whole lot of contractors who have been trying to introduce equipment. None of it has actually performed satisfactorily to date. We do, by multiple use of certain equipment, accomplish this job; but we are still looking for ways so that we can fulfill this requirement to keep the bases clear in support of the Strategic Air Command and the Air Defense Command. That is the reason we are looking for these different ways in order to get this job accomplished.

Now, this new jet proposal looks quite attractive. Actually, we are only trying to get hold of the equipment and run some validation tests on it. As I understand, this is being developed by private enterprise with very little Air Force research and development money involved, if any, but most of the money we want to use is to get a test. Now, in conjunction with the test of the equipment so that we can produce the specifications to go out and buy it, it is a most difficult job to come up and have the same conditions to test this equipment at different places. The snow is of different consistency at different places, of a different depth, and there is a whole lot of difficulty in getting a good valid test to produce this equipment. This has been quite a problem with the Air Force for some time.

Mr. MAHON. That was a helpful comment.

NUMBER OF PROTOTYPES IN B–70 PROGRAM

Mr. LIPSCOMB. Yesterday, I believe in answer to a committee member—and it was in regard to the B–70 program—I thought I understood someone to answer they were going to spend the $75 million on one prototype. I had been under the impression there would be two.

Mr. CHARYK. The program on which we are proceeding is the two-prototype program.

Mr. LIPSCOMB. Yesterday, I may have misunderstood.

Mr. CHARYK. The funding will be different in the following years, of course; whether we proceed with one, two, or more.

Mr. LIPSCOMB. Under the present plans, and from the way I understand it, the $75 million is funding for two prototypes; is that correct?

General FRIEDMAN. The President approved a two-prototype B–70 program. The funding to complete the two prototypes would extend through the fiscal year 1962 budget. In other words, the $75 million, and all the work that has gone on previously would carry on with the one prototype with the followon funding in subsequent years to perhaps finish up on the first prototype and extend for the second prototype, so both statements are consistent. There is a two-prototype program approved.

Mr. MAHON. That was a very devious answer which apparently has misled the Secretary as well as the committee.

Mr. CHARYK. I think the situation really is fairly clear. A two-protype program has been approved. The expenditures in fiscal year 1961 might be of the order of $150 million but with only a new obligational authority requested of $75 million. Now, if we proceed with the two-prototype program in the following year, this will require certain dollars, a lower number of dollars obviously being required if we were to proceed with a single aircraft.

General FRIEDMAN. That is right.

Mr. CHARYK. At the present time the planning is for two prototypes.

Mr. LIPSCOMB. On the Pacific coast this is confusing enough without getting it too mixed up. First of all, some people would like to go ahead with a broader program, but I think the understanding is now that with the $75 million this is a program of two prototypes.

Mr. CHARYK. That is the approved program.

Mr. MAHON. You do not mean this would, of course, buy two prototypes?

Mr. CHARYK. This will not buy two prototypes.

Mr. MAHON. It buys a combination of two?

Mr. CHARYK. That is correct.

Mr. MAHON. But why does General Friedman say this is one? I thought it bought the beginnings of two.

General FRIEDMAN. What I am trying to say here is that in order to complete the second prototype, we would require additional funds in the fiscal year 1962.

Mr. MAHON. Would you not have to have additional funds if you completed the first prototype?

General FRIEDMAN. I believe there would be an amount required in 1962 to finish the first prototype. In other words, we do not need all the money in 1 year. We are not signing a contract for delivery of a given number of aircraft. We have a program and a program objective approved. The financing required in 1961 on top of all the previous financing is sufficient to get us going on this two-prototype program. We will need additional funding in 1962 to complete.

Mr. MAHON. Either one or both?

General FRIEDMAN. Yes.

Mr. FLOOD. You never put a glove on him. You never touched him.

Mr. MAHON. Be sure and get this correct for the record. Everyone has been coming here saying two.

General FRIEDMAN. It would be misleading to say with the $75 million plus prior year appropriations, that is sufficient to finance two prototypes. It is not.

Mr. MAHON. Is it sufficient to finance one?

Mr. CHARYK. No. Actually, it would require something of the order of $80 million in the following fiscal year to proceed with one, and approximately an additional $50 million more to proceed with two.

Mr. MAHON. I yield to no one in my admiration for General Friedman because he has an amazing grasp of these matters.

Mr. THOMSON. Could we just at this time clarify the record? Do you start construction of any airplane this year out of the $75 million—actually build the fuselage?

General FRIEDMAN. Yes, certainly.

Mr. THOMSON. Do you start the construction of one or two?

General FRIEDMAN. The approved program is to proceed with two.

Mr. MAHON. That is not the question.

Mr. THOMSON. What are you going to do with this $75 million, actually start building the fuselage of two airplanes?

Mr. CHARYK. Actually the two aircraft would have flight dates, depending upon the funding in 1962 which might be 4 or 5 months apart, so there would be a spread in the initiation of construction on the two different prototypes.

Mr. THOMSON. It is your plan to start two but you are hedging by saying that you might only start one: is that the proposition?

Mr. MAHON. A Colonel back there behind General Friedman wants to say something.

Colonel HUNN. We have authority to go ahead for two prototypes.

Mr. MAHON. Yes.

Colonel HUNN. The funds that we have now are for the development, and all the necessary research, leading to initiation of prototype fabrication. To complete the first and initiate the second prototype we will need more money as the Secretary said.

Mr. MAHON. I guess General Friedman is right, as usual.

Mr. LAIRD. I thought he changed his position a minute ago.

General FRIEDMAN. Off the record.

(Discussion off the record.)

General FRIEDMAN. I think the honest answer is that subsequent-year financing will be required to complete either one or two prototypes.

Mr. FLOOD. Will you yield to no one and be tranquilized by General Friedman?

CHARACTERISTICS OF NEW AIRCRAFT FOR MATS

Mr. LIPSCOMB. Mr. Secretary, we discussed the $50 million for MATS, and I understand that it is coming out of the "Procurement" account. You enumerated some of the qualifications needed for the MATS planes.

When another Secretary was before us he set forth the requirements for such an airplane that will do the job for MATS. This had to do with 40,000 pounds, 4,000 nautical miles, 5,000-foot runways, and also he added that the plane must be capable of fitting in with the Army requirement as well as the Air Force requirement.

There has been no relaxing of these qualifications with regard to the type of plane that is needed in discussions going on for an improved MATS aircraft?

Mr. CHARYK. We have coordinated this requirement with the Army and with the Federal Aviation Agency, and it is my understanding that the requirement as it now stands is satisfactory from the viewpoint of the Army as well as the Federal Aviation Agency.

Mr. LIPSCOMB. You implied yesterday there was a decision about to be made, and also that you were looking at present airframes available. Have you relaxed your requirement for an aircraft that will

allow troop airdrops? It is my understanding that the speed of the available aircraft may be so fast that you cannot do this.

Mr. CHARYK. Actually, I think the answer to that is that the special features are not required in all aircraft. In other words, there are certain aircraft in which the ability to drop troops, for example, would be important. It does not follow that all aircraft would have to have that capability, so it really gets down to the mix of aircraft and whether the particular mix of aircraft will do the job that is necessary to be done.

I think that the true state of affairs here at the moment is that the Army is continuing to study the SOR that was prepared. They will undoubtedly have some additional comments to offer. I think the same thing is true of the FAA.

Now, the decision that I referred to yesterday had to do with whether the money would be spent in procurement of existing aircraft, or in the procurement of existing aircraft that had been modified to be satisfactory for part of this job, or whether we should initiate the development of a new aircraft along the lines of the operational requirement.

Mr. LIPSCOMB. We do not want to lose sight of the fact that we want to build a capability in our airlift capacity and not just spend money to get more planes.

Mr. FLOOD. If I may add to impress upon the Air Force, the purpose of this is to transport the Army, not to run another airline again. Let us not have this MATS business all over again. The whole thing here is to transport soldiers and hardware. Let us not lose sight of that. I am sure that is what you mean, Mr. Lipscomb. They will lose sight of it in 5 minutes if you do not watch them.

Mr. MAHON. Mr. Laird.

DEVELOPMENT OF INTELLIGENCE DATA HANDLING SYSTEM

Mr. LAIRD. General Wilson, in your statement on page 13 you make the following statement:

> The intelligence data handling system is an integrated system for collecting, processing, analyzing, storing, and disseminating intelligence information.

My question to you is: "Why must the Air Force develop such a machine?"

General WILSON. Of course, we must have some means for utilizing our intelligence in a prompt manner.

Mr. LAIRD. You do not feel that the Central Intelligence Agency and the NSA, or any of these other agencies should be in this particular area?

General WILSON. Oh, yes; they should be.

Mr. LAIRD. But you think it is the Air Force's primary responsibility?

General WILSON. We feel that we should take the leadership in this area.

Mr. LAIRD. Is that agreeable with the CIA and all of the other agencies involved in information matters?

General WILSON. This matter has been coordinated with them, and as far as I know, it is, sir.

Mr. LAIRD. And they are not going forward in the development of this machine?

General WILSON. I believe they are going forward in the development of equipments of their own.

Mr. LAIRD. Are all three of you going forward in the development of this type of machine?

General WILSON. That I cannot say, sir.

Mr. LAIRD. Should not that be cleared up?

Mr. CHARYK. I might be able to clarify that. Actually, the Air Force has certain peculiar, or particular intelligence data processing requirements, particularly related to the role of SAC. We are studying at the moment what can be done from the automation point of view in handling this kind of information. We have requested, and discussed, as a matter of fact, with CIA and with the NSA, the various aspects of our program, and there are representatives from the intelligence community in close contact with our activity at Omaha at the present time.

Mr. LAIRD. Is this being coordinated with the POLARIS task group which is also in this area?

Mr. CHARYK. I am not sure whether there has been a specific tie-in there. We, of course, are working directly with the people in the Office of the Director of Defense Research and Engineering who are aware of the POLARIS requirement as well.

Mr. LAIRD. What is the difference between the POLARIS requirement and the SAC requirement in this area?

Mr. CHARYK. This gets into the whole question of strategic targeting and at that point gets out of my sphere.

Mr. LAIRD. It is in your budget.

Mr. CHARYK. As far as the development of the data processing system is concerned, this has nothing to do with the targeting problem for the SAC fleet and POLARIS.

Mr. LAIRD. But this kind of system——

Mr. CHARYK. The system has broad application.

Mr. LAIRD. It has an application in this particular area and it applies to both. It also applies to the CIA and NSA.

Mr. CHARYK. Absolutely.

Mr. LAIRD. Here is an area where I want to be sure in my own mind that all these agencies are not going forward in this research and development program. There are only so many people we can afford to put into research and development. We have a shortage of these kind of people and I just wanted to make sure this is being properly coordinated. All I want to know is, is it, or is it not?

Mr. CHARYK. I would say that it is certainly being coordinated. What we are studying here is the degree to which you can introduce automation into intelligence data handling. Depending upon the results of this research, there would then be developed various systems for specific purposes.

MEDICAL AND BIOLOGICAL RESEARCH

Mr. LAIRD. Let us take a look at your medical and biological research that you contemplate in the fiscal year 1961. What is the total amount of dollars being spent in that area?

Colonel HUNN. We do not have anything specifically directed toward medical sciences, as such. We do have some basic research in

the bioscience area, $2.7 million in 1961. There are other areas in applied research that would apply to this, but we do not have it broken out and identified as medical cost. We can supply that for the record.

(The requested information follows:)

The Air Force has no research project to establish and isolate disease organisms; to determine the biologic mechanism through which such organisms produce sickness; to develop drugs or medicines to destroy disease organisms, and to treat specific disease symptoms. In this sense, the Air Force does not have a medical research program.

We do propose to spend approximately $150,000 during fiscal year 1961, to evaluate methods for treating certain diseases particularly where accepted treatments, drugs, or medicines produce side effects which delay return to flying duties. These funds will also be used for a number of studies designed to improve the medical service at Air Force hospitals by speeding examinations, diagnosis, and methods of patient care.

Medical conditions, ailments, and diseases which have no particular consequence in every-day living assume critical importance when an individual is placed in control of a supersonic weapon system where he is required to take split second action while faced with the additional burden of gravitational, thermal, visual, and other stresses. It is essential that we know the effects of physical disorders on performance of critical tasks.

An outstanding example of a problem in this area is syncope (unexplained loss of consciousness). Approximately 40 percent of our population has experienced loss of consciousness at one or more times under conditions which may indicate a heart or circulatory disturbance. We must know the likelihood of loss of consciousness occurring in flight; the effects of flight stresses upon the chances that an individual will have additional syncope experiences, and the extent to which loss of consciousness forecasts progressive deterioration of heart and circulatory functions. We must find ways to detect the onset of the condition early enough to prevent its happening in pilots or other people in critical assignments. In this area, broadly termed aviation medicine, the Air Force proposes to spend approximately $600,000 in fiscal year 1961.

The term "aviation medicine," as used by the Air Force, also includes research to determine the effects of flight and other environmental stresses on normal biological functions and human abilities. Determining the effects of heat and lowered barometric pressure on cardiac function, on vision, or on the ability to perform complex flying tasks is typical of this area. The Air Force proposes to spend approximately $1.3 million in this area in fiscal year 1961.

The final area in what the Air Force terms "aviation medicine" is concerned with developing equipment concepts and procedures for overcoming the harmful effects of operational stresses or to prevent hazardous exposure. The Air Force proposes to spend $1.1 million in this area during fiscal year 1961.

The remaining $2.4 million proposed by the Air Force in the general area of medical and/or biological research covers work to develop specific items of protective equipment and to provide life support equipment and techniques in advanced weapon systems.

The total fiscal year 1961 program for medical and biological research, as indicated above, amounts to $5,550,000.

Mr. LAIRD. You are doing some work in the area of space medicine?

General WILSON. Yes.

Mr. LAIRD. How many projects do you have in the area of space medicine? You are also doing some work in radiological and environmental health problems?

General WILSON. Yes.

Mr. LAIRD. You have several contract laboratories that are devoted entirely to that particular area.

Mr. CHARYK. We have an extensive program. We would be happy to provide the details of the program.

Mr. LAIRD. I am sure that $2.6 million does not give a true picture of this particular type of work that is being carried on by the Air Force.

Colonel HUNN. That is correct. That was only for the basic research program. In the applied research program we have another program entitled "Aero Space Environment," and this year we are showing $9.8 million that would be applicable to that type of work.

Mr. LAIRD. But you have no particular breakout here of your program that can be attributed to medical research. I include in medical research, environmental health, radiological health, biological sciences that you are working on, and so forth. You have no figure.

Mr. CHARYK. We would have to provide that for the record. Actually, this would enter into quite a number of accounts, for example, the School of Aviation Medicine which is outside the Air Research and Development Command.

Mr. LAIRD. How do you coordinate this program with the National Space Administration, the Army, the Navy, the Atomic Energy Commission and the National Institutes of Health?

Just to give you a few examples, the Atomic Energy Commission is spending in this year's budget over $50 million in this area of basic research and in training of personnel, and in the dissemination of information they are spending $14.5 million.

When you get over into the area of the National Institutes of Health you will find a much larger expenditure. You will find a big expenditure in the Navy, the Army, and in the Space Agency.

These programs are all involved with medical doctors and Ph. D.'s in the research field. I want to know how they are coordinated.

Colonel DICKSON. Sir, these programs are coordinated at the Secretary of Defense level in research, development, test, and evaluation. They have a medical doctor up there under Dr. York, in one of his offices. These are coordinated between the services at this point.

Mr. LAIRD. What is the amount of overhead you allow on these contracts?

Colonel DICKSON. We will have to supply that answer for the record, sir. I do not have the information immediately available.

(The information requested follows:)

Overhead varies from about 90 percent to 125 percent. It is composed of the following significant elements:

	Percent
(a) Basic overhead (social security retirement, medical, vacation, etc.)	**20**
(b) Other overhead (shelter, heat, light, airconditioning, etc.)	**30**
(c) General administrative expense including equipment and laboratory use charges (depreciation)	**40–75**

Overhead is applied on a direct labor dollar basis except that laboratories and specialized equipment usage depends on the actual use of the equipment.

COORDINATION OF AIR FORCE MEDICAL PROGRAMS WITH THOSE OF OTHER AGENCIES

Mr. LAIRD. Does Dr. York's office go over each of these projects?

Colonel DICKSON. Yes, sir.

Mr. LAIRD. He is the project engineer?

Colonel DICKSON. No, sir. He reviews the project.

Mr. LAIRD. He reviews all of these projects?

Colonel DICKSON. Yes, sir.

Mr. LAIRD. Somebody in his shop then reviews the AEC projects and the National Space Agency and the National Institutes of Health projects?

Colonel DICKSON. I cannot answer that question, sir. I know that the service contracts and projects are coordinated.

Mr. LAIRD. But in your particular program you are not concerned with these programs going on in the other agencies?

Colonel DICKSON. I can say, sir, that they are coordinated, but I do not know at what level or how.

Mr. CHARYK. Actually, the best coordination on this type of thing is normally accomplished at the working level. For example, in our basic research program we have very close relationships between the Office of Scientific Research and the Office of Naval Research and the corresponding body in the Army. The people at the working level are in frequent communication. In the initiation of new programs, and so on, there is generally a check with the other organizations as to whether they are conducting work along the specific line which it is proposed to initiate.

There is no formal method for coordination at higher levels. We have found that on these more basic programs they are most successfully coordinated at the level of the people who are actually directly responsible for the work.

Mr. LAIRD. Of course, you have so many people in this particular area, I do not see how you can coordinate all the projects of the Federal Government properly. When you have hundreds of contracts in the National Institutes of Health, well over 100 in AEC, and the National Space Agency is going into these contracts, I cannot understand how you can rely upon a coordination on the basis of the people who are actually doing the work.

General FRIEDMAN. Mr. Laird, I am sorry, I cannot respond specifically or satisfactorily to your question now. I do know that last year in response to a special request from a member of this committee—I do not recall who it was—I sent over a very elaborate report showing the types of forms, the flow of the forms, in all areas of medical research. I recall after having gone through that, the system was far tighter than I had ever thought it was. I really do believe that this area is pretty well taken care of from the standpoint of duplication or assuring that there is an absolute minimum of duplication.

I know also in the review of the budget estimate by the Bureau of the Budget, we went through item by item in both the space field and the medical field with the view that BOB was looking at it from the exact view from which you are speaking. While I would be the last one to say there is no instance of duplication, I really think the mechanism is such as to hold this to an absolute minimum.

I would like to make a resubmission—I am sure we have a copy of it—of the report and procedures which are set up so the committee might have it this year.

(The report referred to was submitted to the committee.)

Mr. LAIRD. I would like to find out who is in charge of approving these contracts in the Air Force.

Mr. CHARYK. It would depend on the organization which is sponsoring the work. It would be different, for example, in the case of the School of Aviation Medicine than it would be in the case of the activity at Wright Field. One is under the Air Research and Development Command, and the other is not. The responsibility for the contract would vary depending upon the supporting organization.

Mr. LAIRD. I believe you have in your budget here almost $100 million?

Mr. CHARYK. That is a difficult number to come by, because it cuts across many accounts and involves, as I indicated, quite a number of laboratories, some of which are not in the Air Research and Development Command. I think we can put together the total and submit it for the record.

OVERHEAD RATE

Mr. LAIRD. You appear to be using an entirely different system than is used any place else in the Government, particularly when compared with the National Institutes of Health. I believe if you will survey some of your contracts you will find you are paying overhead as high as 40 percent. The National Institutes of Health is not paying any more than 15 percent in any one of their research grants.

Mr. CHARYK. I cannot comment on that, Mr. Laird, because I do not know. I think one has obviously to look at how overhead rates are calculated, and they do vary widely. For example, even among universities, the way the overhead is calculated varies radically.

Mr. LAIRD. It is your responsibility to see that this is handled properly.

Mr. CHARYK. That is correct, but on the other hand, I think it is dangerous to compare percentage overhead rates at two different universities, for example, because they compute the overhead frequently in quite different ways. You have to be familiar with their bookkeeping procedures.

Mr. LAIRD. Do you use the Bureau of the Budget's formula?

Mr. CHARYK. We are using the same procedures we use in all of our contracting operations.

Mr. LAIRD. You are not following the Bureau of the Budget's formula as set forth in their directive of 1959?

Mr. CHARYK. I am not aware of that.

General FRIEDMAN. I am not aware of that, either. However, I would say that if we are deviating from it, I would assume that GAO or our own auditors would have picked it up. I am not trying to make an excuse or anything else. I just do not think we would get away with such a procedure very long without its having come to the forefront, Mr. Laird.

PERCENTAGE OF MEDICAL RESEARCH IN HOUSE

Mr. LAIRD. What percentage of your medical and biological research is done on an intramural basis, within the Air Force, and what percentage is done on an extramural basis?

Mr. CHARYK. We can provide that. I do not have an estimate of that breakout.

(The information requested follows:)

It is not possible to reach a firm or consistent percentage of medical and biological research which is done on an intramural or extramural basis. Many projects done by contract are also supported or partly accomplished by intramural studies.

On the average, basic research in the biological sciences is almost entirely accomplished on an extramural basis. About 95 percent of this area is extramural research. Applied work in these areas accomplished by the Air Research and Development Command averages 40 percent intramural and 60 percent

extramural. This division occurs because of ARDC's emphasis on equipment development which requires outside engineering assistance.

Medical and biological research done by the Aerospace Medical Center and the Arctic Aeromedical Laboratory is about equally divided between intramural and extramural work.

Mr. MAHON. Colonel Dickson had something to say a while ago. Would you make the comment?

Colonel DICKSON. Yes, sir. I wanted to point out that in the Air Force the total program is coordinated. The Air Research and Development Command has the responsibility to join with the Air Training Command, which has the School of Aviation Medicine, and come in with an integrated program. So when we get the program at headquarters, it is an Air Force program which has been coordinated between the two commands which have the primary responsibility.

GUIDELINES FOR APPROVAL OF PROJECTS REQUESTED

Mr. LAIRD. Getting away from the area of medical and biological research and looking at the whole area of project approval for research, what are the guidelines that you use in determining whether you approve or disapprove of a particular project request?

General WILSON. This is a long and involved sort of process. We attempt to have our research responsive to Air Force needs. It is very difficult to make basic research responsive, but we are endeavoring to keep it within certain areas that we identify eventually of interest to us. There are 27 of these areas. All of the proposals are sifted into one or another of these areas. In them we have to apply a priority system as we do in the case of all of our programs, to select those which we consider most immediately responsive to our needs. It is in this process of establishing the priorities that we select the ones which are of most interest to us. You understand that there are probably tens of thousands of proposed research tasks, of which I believe we have between 1,000 and 1,500 approved.

Mr. LAIRD. But in these approvals you do not have set guidelines which you follow. You look at each one and approve it on its own merits as far as the Air Force mission requirements.

General WILSON. Yes.

Mr. LAIRD. And also as far as the financial considerations involved.

General WILSON. Yes.

Mr. LAIRD. I am one who feels you have to look at the financial factors. Perhaps, you have to look at the Air Force mission first and then the financial considerations.

General WILSON. That is correct, sir. Each mission area, each general area of research, each of the 27 areas, is under the supervision of an officer who looks at things to be done within this area. He is governed by need and by money. This establishes his priority. Out of this combination is sifted the jobs to be done. But each of these projects is looked at on its own merits.

CONSTRUCTION FUNDED WITH R.D.T. & E. FUNDS

Mr. LAIRD. You have gone into construction programs under your research program on an unmatched basis at some of our universities and colleges throughout the United States.

General WILSON. Construction programs?

Mr. LAIRD. Construction costs are paid out of this particular budget; is that correct?

General WILSON. For equipment, but not for buildings.

General FRIEDMAN. I am not aware. We submitted a report recently on the amount of construction funded out of the "Research and development" appropriation in the last 4 or 5 years. As I recall, there was none. This is the substance of the report we submitted. There were certain research and test facilities constructed out of industrial facilities moneys within the procurement appropriations. However, this is becoming a very small amount or relatively small amount as time goes by. Really, most of our moneys in this appropriation are for several items—for laboratory and test equipment and not for brick and mortar, as General Wilson pointed out. There are a few projects funded from industrial facilities moneys, but none from "Research and development" appropriation moneys.

Mr. LAIRD. I am not talking about Air Force installations. I am talking about universities and colleges.

Mr. MEYER. Sir, we have never financed out of the "Research and development" appropriation any construction at the universities or nonprofit organizations. We were given the authority under Public Law 557 some years ago, but as indicated in our reports to Congress annually we have not used this. If we do use it, it has to be with the approval of the Secretary of the Air Force, and then Congress has to be notified. We have not used it yet, sir.

Mr. LAIRD. So you are paying for rentals. You pay the rent.

Mr. MEYER. We do rent.

Mr. LAIRD. You pay rent on a 100-percent basis at these nonprofit institutions?

Mr. MEYER. Where they have to rent space, it would be part of their costs in the contract, sir.

Mr. LAIRD. It would not be in their overhead expense?

Mr. MEYER. That is correct. It would be a direct charge.

Mr. LAIRD. It would be a direct charge and not included in their overhead expense?

Mr. MEYER. Not as far as I know.

Mr. FLOOD. This is like a British drawing room comedy. It is very intimate, but down here we cannot hear half of it. I am sure it is very exciting, but I don't know what is going on. I can't hear you. Just raise it up a few decibels.

AIR FORCE CONTRIBUTION TO ANTISUBMARINE WARFARE

Mr. LAIRD. What funds are in here for the Air Force to increase its ASW capability?

General FRIEDMAN. Antisubmarine warfare? Is that what you mean by ASW?

Mr. CHARYK. I am not sure there are any dollars in the program for ASW. On the other hand, there are undoubtedly items of research which might conceivably have some connection with the ASW problem.

Mr. LAIRD. What are you doing to make your air defense patrols capable of detecting submarines?

General WILSON. We have no direct project in this line to my knowledge, but we do have work at the Lincoln Laboratory on radiation, propagation, and detection, which might be useful in this area. Of course, the Navy——

Mr. LAIRD. It seems to me the way the Air Force is going, the only way you could detect a submarine is to fly your planes upside down. It seems that as far as our whole defense posture is concerned, you have a responsibility, when you have planes out on a mission. The requirements have been written for the Air Force which include ASW.

General FRIEDMAN. As a collateral responsibility.

Mr. LAIRD. I wondered what you were doing in this area as far as research and development in order to meet that requirement which you are not meeting at the present time.

General WILSON. This is a collateral requirement. We are required to support the Navy. At the moment, to my knowledge we have no projects which are specifically tailored to this need, but we do have a lot of projects which support the general area.

The Navy is very much aware of the work which is being done in this area. That is the extent of our support of the Navy's mission.

Mr. LAIRD. You believe the Navy should fly all the planes which have anything to do with ASW, I take it, then.

General WILSON. They are charged with that primary mission, yes, sir.

Mr. LAIRD. You are also charged with this as a secondary mission, according to your own requirements which have been written by the Air Force.

General WILSON. As a collateral mission, yes, sir, as a supporting mission.

Mr. LAIRD. In all the reports I have gone over at the various stations from your patrol planes, they have never even lowered their altitude. They have reported sightings, but someone else has to fly another plane all the way out to find out if it actually was a submarine or were not a submarine. It seems to me that there should be something aboard those planes so you would not have to send two planes out every time an Air Force plane reports a sub.

General WILSON. We have no projects in this area.

Mr. CHARYK. Actually, the A.E.W. & C. aircraft are being equipped with new radar equipment, and also with airborne long-range input equipment to handle the low-altitude threat. This, of course, is a secondary item, to the antisubmarine problem itself.

Mr. LAIRD. When you talk to the people who are actually flying this type of plane, they tell you that the Air Force has not developed that capability of detection and that they cannot perform this mission which they have been assigned.

Mr. CHARYK. The low-altitude capability is being introduced into the A.E.W. & C. aircraft. This consists of the APS 95 radar and the ALRI, the so-called airborne long-range input to the SAGE system.

Mr. LAIRD. This is in your shop.

Mr. CHARYK. That is correct. This is specifically geared to the low-altitude threat, air-breathing threat. I indicated it was secondary. It does not address itself to the problem of submarine detec-

tion. The inputs would come into the SAGE system, which would then direct the appropriate counterforces, be they interceptors or BOMARC missiles.

Mr. FLOOD. Well, if you insist. He said that laughingly, so it is all right.

Mr. MAHON. Any questions?

Mr. FLOOD. Mr. Laird, I hoped you would pursue that.

Mr. LAIRD. My time has expired.

Mr. FLOOD. Take 5 minutes of mine from next week. I think you have a very important premise there, and I wish you would find out what happens.

Mr. MAHON. Do you understand the problem which has been presented here? Can you give a brief résumé of the problem at this point in the record?

General FRIEDMAN. Yes, sir. I would like to put an insert in the record at this point.

Mr. MAHON. I do not think we want the insert. Can you now give a general and satisfactory answer to the question which has been posed?

General FRIEDMAN. Sir, I think the answer you seek is this: When we talk about a collateral responsibility, we are talking about a responsibility to assist another service to the extent that our existing equipment, personnel, and so forth, would permit rendering such assistance. It does not involve our going out and developing or procuring equipment to perform a mission specifically assigned as a primary responsibility to another service.

(The following statement was later submitted:)

The following information is submitted regarding collateral functions of the Air Force:

(*a*) Unified Action Armed Forces, JCS 2, states:

"20403. COLLATERAL FUNCTIONS OF THE AIR FORCE

"To train forces—

"(*a*) To interdict enemy seapower through air operations.

"(*b*) To conduct antisubmarine warfare and to protect shipping.

"(*c*) To conduct aerial minelaying operations."

The responsibility for coordination with the Navy regarding antisubmarine warfare is delegated to CONAC. In addition, SAC and TAC have the assigned responsibility of antisubmarine warfare as a corollary mission.

With reference to the Air Force procurement of specialized equipment to perform collateral functions, the following is a quotation, in part, of paragraph 20101j, Unified Action Armed Forces:

"The forces developed and trained to perform the primary functions set forth hereinafter shall be employed to support and supplement the other services in carrying out their primary functions, where and whenever such participation will result in increased effectiveness and will contribute to the accomplishment of the overall military objectives. As for the collateral functions, while the assignment of such functions may establish further justification for stated force requirements, such assignment shall not be used as the basis for establishing additional force requirements."

Mr. LAIRD. Mr. Chairman, the only reason I bring this up is that the cost involved in this particular problem is tremendous.

Mr. FORD. The ASW, you mean?

Mr. LAIRD. When you have a plane out there and they see an object which they think is a submarine, they report back and send another plane out to make sure what it is. This BMEWS and everything else

we have will not be worth a darn when the Russians start having submarines off our coast with missiles on them. The Air Force is not prepared to do anything about this at the present time, and it seems to me that we cannot wait around forever to get this problem well in hand.

Mr. FLOOD. Mr. Laird, they have an arrangement, you see. This is a jurisdictional problem between the Navy and the Air Force. They cannot kill that submarine. That is not in the book. There would be trouble.

Mr. FORD. With all due deference to both my friend Mr. Laird and you, Mr. Flood, I suspect if we found the Air Force was putting money into a program which involved another service, there might be some eyebrows raised.

Mr. LAIRD. They would be fairly well if they flew them for a while upside down.

Mr. FLOOD. I think at least what I have in mind is that there should be an examination of this policy or purpose. I do not know if it is right or wrong.

Mr. LAIRD. That is why I brought it up.

Mr. FLOOD. Maybe it should not be done at all, and maybe it is ridiculous, but it just seems to me if I am flying a bomber at X thousand feet and I see a submarine, I should not have to say, "Isn't it a shame I can't kill that?"

General FRIEDMAN. Mr. Flood, I assure you that is not the case. The responsibility for coordinating this collateral mission, as assigned to the Air Force, is centered in the Continental Air Command. There would be no restriction on our part or hesitation on our part to destroy the submarine. When we are talking about antisubmarine warfare, I believe Mr. Laird was talking more to the search and identification than he was to the actual destruction. If the aircraft that were in the vicinity had the ammunition on board to perform that particular function and he could positively identify the submarine and he was in an area which, shall we say, was such as to permit such an act, there would be nothing to preclude his doing it. As a matter of fact, he would be instructed so to do.

Mr. FLOOD. Of course, you know the problem the infantry have of having your own artillery dropping a barrage in your back hip pocket is very unpleasant business. It is the problem of killing the right submarine.

Mr. MAHON. In order to expedite the hearing, let me ask, Colonel Harrison, that you secure the transcript of this proceeding of the last few minutes, that you make it available to the Navy, and that the Department of Defense coordinate this thing and give us some sort of answer through the Navy and the Air Force.

Colonel HARRISON. Yes, sir.

Mr. FLOOD. We are not urging any kamikaze tactics. We don't expect this pilot to dive and crash on this submarine.

U.S. AIR FORCE CONTRIBUTIONS TO THE U.S. NAVY'S ASW EFFORT

Of all the tasks performed by the Navy, antisubmarine warfare (ASW) contains more complexities than any other. It is a task that is continuously pursued at all times. It is a task that requires active, vigorous prosecution under normal cold war conditions, periods of international tension, as well as

during periods involving combat operations. This ASW task devolves primarily upon the Navy by virtue of its explicit assignment as one of the combatant functions of the Navy.

The statutory assignment of combatant functions to the services provides suitable guidance for the development of militarily effective forces provided to the various unified and specified commands. This assignment of responsibilities, primary and collateral, provides also a practical means for prevention of unnecessary duplication in military techniques and weapons systems. At the same time we have sufficient flexibility and an absence of narrow restriction so that the overall capabilities of the forces of each service may be utilized either alone or in coordination with the forces of other services to achieve combat effectiveness. Thus the forces developed and trained to perform the primary functions assisgned to one service are employed to support and supplement the other services in carrying out their primary functions when and whenever such participation will contribute to the accomplishment of the military mission. On the other hand, a service's collateral functions, exemplified by ASW in the case of the Air Force, may establish further justification for its stated force and associated equipment requirements; however, such a collateral function is not the basis for establishing additional forces and equipment requirements.

It is a specified function of the Navy to organize, train, and equip naval forces for ASW, including the air aspects thereof. This entails the development and constant revision of combat doctrine for the effective employment of naval forces. Combat doctrine is inextricably concerned with the composition of forces, their training and equipment as well as research and development related thereto.

The basic problem of the Navy is control of the seas. ASW is an important factor in this control which requires virtually complete knowledge of all that moves at sea. While such control never has and probably never will be absolute, our objective is control of the sea for the accomplishment of our national objectives. Practically all naval operations contributes not only to the desired control of the sea but to ASW operations as well. ASW is an organic part of naval operations and is accomplished by many types of forces. The general operational types or phases of ASW include: mining of waters off enemy bases and in selected areas to deny access to the sea; conduct of hunter-killer operations, and protection of shipping in the open oceans; attacks on enemy bases; attacks in waters near enemy bases; as well as the defense of sea areas contiguous to the United States.

ASW begins with good intelligence collection, analysis, processing, and useful dissemination. Any information as to the characteristics, numbers, movement, patterns of operations, and location of submarines is of value in ASW. Many sources of information are utilized in gaining the appropriate intelligence. Commercial airline pilots flying transoceanic flights, merchant ships, pleasure craft, civilians sightings from the coast, civil air patrols, coast guard ships are some of the many sources utilized in obtaining ASW intelligence. Every reported submarine sighting, regardless of source, is evaluated and if questionable, is investigated.

Based on available intelligence the next step is to keep the enemy submarines under surveillance. This requires special equipment. In order to accomplish meaningful surveillance, shore based and carrier based aircraft, surface ships, submarines, as well as fixed underwater surveillance systems are utilized. These ships and planes are configured with equipment providing detection, localization, and in most cases a kill capability. Just as antiair warfare, amphibious warfare, land warfare, strategic bombing, ICBM's, and POLARIS call for military forces having particular characteristics to enable them to be effective, so does antisubmarine warfare require ships, submarines, aircraft, and armament, that is, weapons systems, which must be designed for the particular tasks to be performed.

It is an inherent limitation, then, that a weapons system which was designed to accomplish a task may have only limited, or even no capability to perform in the ASW area. This is especially true with aircraft where the weight and space must be utilized efficiently, resulting in specialized equipment built with the foremost purpose of the aircraft's mission. Similar considerations prevail in radars, rockets, and armament. Thus, it often happens that there is little residual ASW ability in a weapons system having another mission.

It is seldom that there occurs an actual ASW situation which can be dealt with effectively by a single unit. Antisubmarine warfare is an oceanwide effort, requiring vast amounts of intelligence on both enemy and own forces, coordination amount our own forces, several types of detection and identification equipment as the submarine varies his tactics and defensive moves, and finally particular kinds of ordnance to make the kill. The contributions made by all units are fed into the ASW system in order that the whole weight of that system can be brought to bear upon the enemy.

The Air Force, in accordance with its collateral responsibility for ASW, makes significant contributions.

Its aircraft making overwater flights participate in a worldwide submarine sighting system. They, as well as those naval aircraft not configured for ASW, report into this system all objects which might possibly be submarines. These reports contribute to the total ASW effort, thus permitting forces with the required capabilities to be brought to bear.

In summary, the Air Force can and does assist the Navy operationally in ASW, by——

(*a*) Furnishing operational intelligence.

(*b*) Conducting air surveillance of shipping lanes and shipping focal points during scheduled flights.

(*c*) Providing resources for special sea search missions in cases of necessity, consistent with the performance of the primary Air Force missions.

(*d*) Providing available Air Force base facilities to naval aircraft for limited periods of time.

(*e*) Special strike missions in time of war.

Implementation of the above ASW support is provided for in existing agreements among the cognizant Navy and Air Force operational commanders and has proven satisfactory in practice.

AGENA–B AND CENTAUR

Mr. MAHON. Mr. Thomson.

Mr. THOMSON. Referring to page 9 of your statement, Mr. Secretary, I notice you state that with the advent of the AGENA–B, you mean this year, I take it.

Mr. CHARYK. Yes.

Mr. THOMSON. And next year the CENTAUR, the capability will be further enhanced. Those are on schedule, are they, and you anticipate having the AGENA–B this year and the CENTAUR next year?

Mr. CHARYK. Yes, we do.

MINUTEMAN PROGRAM

Mr. THOMSON. With respect to the MINUTEMAN program, page 7, you indicate that everything is going all right and you have confidence in the achievement of the scheduled goals. Some problems have been reported so far as the propellant, for example, cracking and getting the proper range due to variation in burning. Do you think you will have that solved within the time limit? Do you have confidence in the system?

Mr. CHARYK. We certainly have development problems remaining in the program. On the other hand, solutions do appear to be in hand. The full determination of whether they are solved, of course, will depend upon firings which are still in the future.

Mr. THOMSON. With regard to the MINUTEMAN, there would be substantial savings because of no personnel being required at the site. Is R. & D. responsible for the development of that as the security phase, or is that turned over to SAC?

Mr. CHARYK. The development of the system in a fashion that would permit a minimum of servicing is, of course, an R. & D. responsibility, and the system is being designed with a view toward reducing to an absolute minimum the amount of service work which has to be carried out.

Mr. THOMSON. Actually, you are looking forward to no personnel at the missile site, is that not correct?

Mr. CHARYK. That is correct.

Mr. FLOOD. Will the gentleman yield to me on MINUTEMAN? I want to read from one of the weekly magazines, Newsweek, March 14, which will make you all very happy.

The old Army Game. Brass hats here are quietly working out plans which would give Army Engineers a major role in operating the Air Force's railway-mounted MINUTEMAN missile. The Air Force, of course, will fight it tooth and nail.

You see what happens to you fellows when you try to take POLARIS. It is a two-edged sword, you see.

Mr. THOMSON. The question I wanted to ask you on MINUTEMAN is, when it comes to the site selection phase do you work with SAC on that, or is that entirely a matter for them to determine?

Mr. CHARYK. This is jointly with SAC. Actually, SAC has the prime responsibility, but with support from ARDC.

Mr. THOMSON. Have you gotten to the point that you are actually looking at specific sites for the MINUTEMAN?

Mr. CHARYK. Yes. I would anticipate that there would be an announcement of the initial MINUTEMAN installation in the not too distant future.

Mr. THOMSON. You are proceeding with confidence in the program, then.

How about the time for installation on ATLAS and TITAN? We had testimony that it takes about 30 months to install a squadron from the time you start with the selection of the site; that it takes about 6 months for design, and then 24 months for the actual construction phase. Has your experience to date indicated what time we might expect, as far as the time lag is concerned, on MINUTEMAN?

Mr. CHARYK. I think at the present time it is the same order of magnitude, although the numbers are clearly not as firm in the case of MINUTEMAN as in the case of the others where we actually have the experience.

Mr. THOMSON. But you do think it will take you almost as long, about 30 months, in order fully to go through the process of selecting the site, design, and construction?

Mr. CHARYK. I think there is a chance that this can be shortened, since the checkout equipment will be simpler, and the installation and checkout is one of the time-consuming factors in the case of the large, complicated missiles. It may be possible to reduce it by the simplicity in the case of MINUTEMAN in this area.

Mr. THOMSON. Have you had any problem as far as having sufficient flight test facilities available on the Atlantic and Pacific missile ranges to go ahead with your program as rapidly as you would like?

Mr. CHARYK. There are scheduling problems at the Atlantic missile range. In cases where the launch pad is damaged and where there is time required for rebuilding, in certain instances rather severe sched-

uling problems have existed. In the case of the Pacific Missile Range, there has been a delay in the first launch pads at Point Arguello. The program there has slipped by the order of 3 or 4 months.

TITAN RESEARCH AND DEVELOPMENT

Mr. THOMSON. In your statement, General Wilson, I think you detailed $406.1 million this year for TITAN research and development. Can you break that down for me? Supply that for the record.

(A classified statement was submitted.)

Mr. THOMSON. Also, I notice under research and development another $3.3 million. I understand there is shifting from one account to the other here, but what is that $3.3 million for?

General WILSON. What page is that on, sir?

Mr. THOMSON. Page 9.

Colonel HUNN. The $3.3 million which is shown on that page is primarily for studies. There will be some study work on the system itself, such things as investigation of the nose cone, finding better means of reentry, reentry speeds, and things of that kind. General research and development on the system itself. We charge that to research and development.

Mr. THOMSON. I was having difficulty understanding why this appeared under research and development while the bulk of it is in the procurement account. I was wondering if you were starting something new.

ADVANCED MANNED FIGHTER PROGRAM

Most of the air defense research and development is shown as being for the MIDAS. Is any work being done for advanced manned fighters? Last year when the Air Defense Command was in, as I remember the testimony, it was along the line that we ought to be thinking about a manned fighter which would have a vertical fly-out capability from a hardened site and would home back to it and have the capability to land. Are you doing any research and development on that?

General WILSON. Not beyond studies for this fiscal year.

MIDAS PROGRAM

Mr. THOMSON. With regard to the MIDAS program mentioned on page 11 in your statement, General Wilson, when do you think we will have that operational?

Mr. CHARYK. I might comment on that. The earliest possible date would be the latter part of 1963. This is really pretty much an estimate, because the operational date will be directly conditioned by the success we are able to achieve in the reliability of payloads and in securing the proper lifetime for satellite payloads. We will have a better fix on that at such time as we actually have a MIDAS vehicle in orbit and can determine the adequacy of the design to do the intended job.

Mr. THOMSON. On the basis of what you know about it now, do you think you can meet the 1963 date? Are you on schedule?

Mr. CHARYK. The first flight, as I indicated in my statement, was unsuccessful. We hope to have another flight within the next few

weeks. I think that the schedule will be strongly conditioned upon the success or lack of success in the case of this next firing.

Mr. THOMSON. Are you indicating you do not have too much confidence in the 1963 date?

Mr. CHARYK. I am saying that I think it is strongly conditioned by the next flight. Perhaps Colonel Evans might have a comment on that.

Colonel EVANS. I would only add that we are on our present schedule and, assuming a reasonable degree of success in our program, we would expect to achieve this capability in 1963.

SAMOS PROGRAM

Mr. THOMSON. Thank you, Colonel.

How about SAMOS. I note from your statement on pages 9 and 10 that you expect a launch on that in 1961. When is it to be operational?

Colonel EVANS. It is due for launch late this year, sir; off the Arguello pad, to start the program.

Mr. THOMSON. Late calendar year 1960?

Colonel EVANS. Yes, mid-fiscal-year 1961, second quarter.

As far as an operational date, none has been established for that system.

Mr. THOMSON. It is on schedule?

Colonel EVANS. Yes, sir. It was primarily affected by this few months' slip in the launch pad. It is on its current schedule, but it has been rescheduled because of the launch pad slippage.

Mr. THOMSON. Thank you, Mr. Chairman.

Mr. LIPSCOMB. Mr. Chairman, there are a couple of items which have been discussed in the hearings before which I would like to refer back to.

Mr. MAHON. All right, I will yield to you.

X–15 ENGINE PROGRAM

Mr. LIPSCOMB. During the discussion I was having with General Friedman, I mentioned that I understood there was $10.9 million to provide for additional engineering on an engine. As I understand it, I believe you would like to correct the record in that regard.

General FRIEDMAN. Yes, sir. We said, I believe, that we were not aware of the $10.9 million figure, as such, when we said that on the X–15 we had $6 million, of which a rather small amount would be applied to the engine. I would like Colonel Hunn to speak a little more fully to that.

Colonel HUNN. The correction is that this was a prior year transfer into the 1960 program. We originally had some $16 million on the X–15. As a result of an engine slippage we had to reprogram and put some more money on the engine that in order to bring it back on schedule so we could install it in the X–15 and continue on with the flight tests.

The money that you noted here, the $10.9 million, was for the engineering work that we had to do in order to take care of the slippage in that program—technical difficulties that they ran into which they had not anticipated caused this.

Mr. LIPSCOMB. What are you doing in the 1961 budget?

Colonel HUNN. Actually, if I read the statement correctly, it says $10.9 million to provide for additional engineering cost on the engine for the X–15, and this was applied to the fiscal year 1960 program, not to 1961. The fiscal year 1961 program in the budget is $6 million.

Mr. LIPSCOMB. As I understand, you have transferred the money. You have already applied the money under this additional engineering cost. This was going on in 1960.

General FRIEDMAN. Yes sir, what we are explaining, consistent with the request of the committee, is any change in our programs. These pages provide the committee with the adjustments in programs between program years. This is merely to bring the committee up to date on the application of prior year funds, and does not constitute a request for new funds.

RESEARCH ON AUTOMOBILE ACCIDENTS

Mr. LIPSCOMB. On two or three other occasions during these hearings, the chairman of the committee has asked you about research studies being made in the area of automobile accidents. Are you now aware of any studies going on at the present time within the Air Force or the Department of Defense?

Mr. CHARYK. I am personally unaware of any such studies.

Colonel DICKSON. I do not know of any studies in the Air Force program connected with this, sir.

Mr. LIPSCOMB. Would anyone be aware of studies going on in the Department of Defense in this area?

Colonel HARRISON. I can find out and have it put in the record, sir. I do not know offhand. That is in 1960 or 1961, sir?

Mr. LIPSCOMB. Any time.

Colonel HARRISON. Any time in the past?

Mr. LIPSCOMB. While you are looking into this, I would like some help in determining where a study is being done in the Department of Defense entitled, "The Effect of Automobile Design Characteristics on the Occurrence of Motor Vehicle Accidents." This, as I understand it, is being done within the Department of Defense, and in fact an Air Force officer is the executive secretary who has knowledge of this particular study.

Colonel HARRISON. I shall determine that information and put it in the record, if that is satisfactory.

Mr. MAHON. Would you give the committee and the Air Force a briefing on the information which you have and how the matter arose, if you know?

Mr. LIPSCOMB. The matter arose in my office. A constituent wrote to me asking why it was that money had been spent on such a study. She felt this study was of value to all citizens of the United States and he wanted to have access to it and had not been able to gain access to it.

I wrote the Department of Defense in this regard, and in turn they referred a contractor to me by the name of Dunlap & Associates, Inc., in Connecticut, at which time they supplied me with a brief summary of the report. The colonel in the Air Force informed me that it was only a brief summary, and the reason was not because of security or

classification or other military reasons, but it is for the purpose of protecting the rights of the author until he publishes his findings in open literature.

I have since heard from the author of this particular study, at which time he informed me that, "I should also like to add that this work is continuing under an expanded program of studies here at D. & A. We are hopeful that within some reasonable period of time we shall have some more definite information to contribute on this study."

To describe the study a little further, I am informed that this study is of off-duty motor vehicle accidents, and the sample is being made through the cooperation of certain large industries in the United States that have fleets of motor vehicles. They are studying the accident rates and also the design of automobiles to determine whether or not the windshield are proper, the body is constructed right, and so forth.

Mr. MAHON. Under whose jurisdiction is this study apparently being conducted?

Mr. LIPSCOMB. Apparently this study is being done by the Armed Forces Epidemiological Board, and the executive secretary is a colonel in the United States Air Force.

Mr. MAHON. Why do you not read the letter.

Mr. LIPSCOMB. The letter which I received from the Department of Defense, Armed Forces Epidemiological Board, is this:

> This is to reply to your inquiry concerning a study made under the auspices of the Armed Forces Epidemiological Board to determine the effects of automobile design characteristics on the occurrence of motor vehicle accidents.
>
> We must obtain the information you seek concerning the findings of the survey you mention from Dunlap & Associates at 429 Atlantic Street, Stamford, Conn. This is not because of any military security classification or other military reason, but is for the purpose of protecting the rights of the author until he publishes his findings in open literature. Therefore, I telephoned Dunlap & Associates yesterday and informed them of your request. Dr. Herbert H. Jacobs of that organization will make photostats of pertinent portions of the findings you requested which he will transmit to you as soon as possible.
>
> Ihope this action on Dr. Jacobs' part and my part will be to your satisfaction. Please let me know if we can be of further service to you on this or any other matters, since we greatly appreciate people's interest in preventing accidental deaths and injuries from automobiles or any other causes.
>
> Sincerely yours,
>
> JOHN RIZZOLO,
> *Colonel, USAF, Medical Corps, Executive Secretary.*

Mr. MAHON. Is that a research and development project, do you think?

Mr. CHARYK. We will have to look into the details of that and report back to you.

Mr. LAIRD. Mr. Chairman, this is in the area of environmental health. The National Institutes of Health are making similar studies and I think that in this whole area of environmental health we have got about every organization in the Federal Government going into it.

Mr. MAHON. Why should we provide funds for the Army, Navy, Air Force, or the Department of Defense to study home accidents, how to make shoes more comfortable in the home or when off duty, or any of these things that just have to do with the general population? Why do we do this in the services?

Mr. LAIRD. You can do a beter job in the Public Health Service.

Mr. MAHON. It looks like they can do a better job. I think there is a great field for improvement here but it is beyond me to understand why the services enter into these kinds of contracts and spend this kind of money unless they just have so much money they do not know what to do with it and someone comes along and says, "Let us make a study for you. We will seek to be helpful." To me, it is utterly unexplicable.

Mr. FORD. Off the record.

(Discussion off the record.)

Mr. CHARYK. I suspect that the Federal Council of Technology might be as good a place as any to refer this type of problem since they cut across all of the agencies and departments of the Government.

As you point out, this is an area in which a great many departments and agencies are interested and that might well be the appropriate body to take a look at the overall Government effort in this area.

Mr. MAHON. Do you agree with me, Mr. Secretary, that this type of research is not the type of research that should be engaged in by the Air Force or other services?

Mr. CHARYK. I would certainly agree with that.

Mr. MAHON. I am utterly unable to understand it.

I shall ask that the Public Health Service and the Department of Defense clarify this for the record at this point, giving us the facts. We do not have time to look under every chip and investigate every project when we have thousands of them. It does no one any good to have utterly indefensible projects financed in the name of Defense. It undermines the confidence of everybody, including the members of this committee, in the defense effort. I hope that we can clean house, if necessary, in these fields.

I cannot possibly know about all of the problems and nobody on the committee could.

(The desired information will be found in the Appendix of volume 7 of the hearings.)

PROCEDURE FOR REVIEWING BASIC RESEARCH PROJECTS

Mr. THOMSON. In connection with this basic research, how do you decide what projects will be undertaken and who will undertake them?

In another subcommittee I serve on, we ran into similar problems and we found it to be the case that an individual submitted a proposal stimulated by the motive of keeping himself on the Government payroll; then it was approved and assigned to him.

Is that the procedure you follow on this basic research?

Mr. CHARYK. In the case of basic research, the proposals are submitted by the potential investigators. In the case of the Air Force they are submitted to the Office of Scientific Research.

The proposals are evaluated and funded according to their merits.

Mr. THOMSON. That is the way we found they handled it in this other instance and, we had an investigation made. We found there that once that proposal was approved, the fellow had a license to work just about as he pleased. We ran into this situation where people would be working 5 or 6 years on this proposal and study and no followup checkup was made on them. In some cases, this had gone on much longer than that without anything being published. It was just a study going on.

How do you prevent that?

Mr. CHARYK. Actually, I think that the most important factor in basic research is the investigator himself. Sometimes it takes a good many years to see the results of a specific undertaking but if one selects an investigator whose reputation has been established I think that this is the best basis we have; namely, the capability of the investigator and the manner in which he is regarded by his scientific colleagues, rather than the specific piece of work he might propose.

Mr. THOMSON. Off the record.

(Discussion off the record.)

Mr. CHARYK. Actually, contractors are required to submit reports also. They are free to publish papers in scientific journals and magazines and make presentations at meetings of scientific societies. It does not take too long until there is established a particular reputation and the quality of the individual's work is generally measured by the esteem in which he is held by his scientific colleagues as a result of these things.

Mr. THOMSON. Does all of this go out on contract or do you have people in uniform and civilian employees, direct hire civilian employees, working on some of these projects that they have submitted?

Mr. CHARYK. There is a certain amount of in-house basic research work that goes on but the bulk of our work is on contract, primarily to universities and nonprofit institutions.

Mr. THOMSON. How about the exchange of information? Is that worked out between people working on similar problems?

Mr. CHARYK. The best channels of communication are actually the scientific journals and the interchange of reports that automatically takes place between scientific investigators in the same field.

Mr. THOMSON. I think that this basic research can certainly get away from us with all the different agencies being allowed funds to conduct it.

RELATIONSHIP OF AIR FORCE AND SPACE TECHNOLOGY LABORATORY

Mr. MAHON. I have before me the March 14 issue of Aviation Week and I note a story entitled "New Agency May End Space Technology Laboratory Controversy."

Previously, Mr. Secretary, I called that to your attention and I would like to explore this just a little.

The March 14 issue to which I have referred makes this statement which I will quote for the record more or less, where the article goes on to say that Secretary of the Air Force is expected to make a decision on this matter based on a report of the Milliken committee which has analyzed the management aspects of the Air Force's ballistic missile and space programs, with particular emphasis upon USAF's in-house capability.

Will you give us the story on what is happening here, briefly?

Mr. CHARYK. Mr. Chairman, the history of the relations between the Air Force and what is now the Space Technology Laboratories goes back to 1954 when the von Neumann committee addressed itself to the question of the importance of developing an intercontinental ballistic missile capability. At that time, the von Neumann committee recommended the establishment of a special management sys-

tem, both within and outside the Air Force to permit the most effective attack on the problem.

The specific way in which this was handled was the establishment at Inglewood, Calif., of an integrated complex consisting of the Ballistics Missile Division of the Air Research and Development Command, as well as the Ballistic Missile Center of the Air Materiel Command with technical support by the Ramo-Wooldridge Corp. Subsequently, the Space Technology Laboratories became a subsidiary of the Thompson-Ramo-Wooldridge Corp. The size of the organization has increased significantly over the 5 years in which it has been in existence.

The Milliken committee was set up by the Secretary of the Air Force to take a look at the entire problem and to recommend to him whether the management structure, as it had been established at that time, was the best solution, both now and looking ahead to the future.

The Milliken committee studied the entire question and recently has submitted a report to the Secretary of the Air Force. The Secretary of the Air Force is involved in determining specific actions that should be taken on the basis of the recommendations of the committee and to insure that the Air Force in the years ahead will have the proper type of management structure to permit the most effective pursuit of its ballistic missiles and space system responsibilities.

Mr. MAHON. Will you insert at this point in the record a brief of what the Milliken committee recommended and what the alternatives are?

(The information follows:)

The Management Study Committee (the so-called Milliken committee) reviewed the Air Force's management scheme for ballistic missile development that had been established in 1954 to meet the particular situation at that time. It considered the desirability of continuation of this method of management, a return to the single weapon system contractor arrangement, as well as the "arsenal" approach.

The committee concluded that it would not be desirable at this time to return to earlier methods of weapon systems management for the large ballistic missile and space programs. This was felt to be particularly true in view of the urgency of these programs, the possibility of disruptions and the proved effectiveness of the procedures employed up to this time. The committee noted that the current management approach had worked extremely well both in terms of technical quality of the results and the speed with which missile system development had taken place.

Nevertheless, the committee felt that it was timely to consider appropriate modifications to permit the establishment of continuing management institutions rather than the continued use of expedients tailored to a pressing problem. It recommended that the role and mission assigned to Space Technology Laboratories be reoriented. It recognized that in the large ballistic missile and military space fields the Air Force would require for the foreseeable future scientific and technical assistance in the areas of advanced planning and evaluation of new ideas, "broad-brush" initial system design, technical evaluation of contractors' proposals, and technical monitoring or limited systems engineering and technical direction of program progress.

The committee felt that this competence must be furnished by a civilian contractor organization occupying a continuing relationship with the Air Force. It also recommended that the detailed systems engineering of specific projects, a function now being performed by Space Technology Laboratories, should become the responsibility of competitive industry, either of a prime manufacturing contractor utilizing subcontractors or of a nonmanufacturing management engineering company using the associate contractor mechanism or major subsystems. The committee also urged the Air Force to continue to develop its own capability to plan, analyze, and procure weapon systems in the ballistic missile and military space areas.

The committee finally recommended that the Air Force seek to implement these changes as rapidly as practicable, but with the recognition that care must be exercised to insure against disruption in the high priority ballistic missile programs.

Mr. MAHON. Will you tell us now when you expect a decision on this?

Mr. CHARYK. We are hopeful that a decision on this may be forthcoming within a matter of weeks.

AIR FORCE USE OF CONTRACTORS TO MANAGE RESEARCH PROGRAMS

Mr. MAHON. This article also states that—

Solution is imminent in the long smouldering controversy on the contractual relations of the Air Force Ballistic Missile Division and the Space Technology Laboratories.

The Air Force has tended to use contractors in its development program to a greater extent than the other services, Army and Navy, which seem to prefer the in-house capability. The whole philosophy of management of Government research programs is involved in this. What are the Air Force's guidelines as to when contractors should be used and when it is important to operate installations with Government personnel, in order to maintain in-house capability within the Air Force?

Mr. CHARYK. By and large, Mr. Chairman, this depends upon the specific program and the in-house capabilities that exist in the Air Force in that particular field, the urgency of the problem, whether it is a temporary situation or a problem of permanent duration.

We have used both mechanisms, both the use of in-house capabilities as well as contractor operations.

Mr. MAHON. You lean more favorably on contractors?

Mr. CHARYK. We have leaned more heavily on contractor methods than inhouse.

EFFECT OF USE OF CONTRACTORS ON CIVIL SERVICE SYSTEM

Mr. MAHON. When a contractor operates Government facilities, he is not restricted by civil service salary scales, statutory limitations, numbers of personnel, and so forth.

I am wondering if, under the contract method, you more or less undermine the civil service system and deprive the Government of control within limits of highly skilled personnel?

Mr. CHARYK. Well, we do attempt to use the contractor method in those cases where the flexibility that this approach permits is important to the most efficient accomplishment of the job. The contractor efforts, of course, can be expanded or pulled back as the programs demand. This flexibility does not normally exist when we use the in-house approach so, again, we have used both and attempt to use the particular approach which does the best job for us.

Mr. MAHON. Actually, you do not have a lot of the best personnel who actually work on these projects sometimes, do you?

Mr. CHARYK. I think it varies depending on the program we are talking about. For example at Dayton, Ohio, the technical support for the aeronautical systems work is provided by the in-house technical laboratories. In the case of the Ballistic Missile Division, the

technical staff support has come from a contract with the Space Technology Laboratories. We have used one approach in one case and the other approach in the case of the ballistic missile program.

Mr. MAHON. You think that your experience in the past should have led you to some different type of approach or a different mixture of approaches on this question, do you?

Mr. CHARYK. I would think that in the future we will have occasion to use both approaches. We have found that in the case of the ballistic missile effort, however, that the contract approach has been most effective and has provided a capability that has been demonstrated by the effectiveness of the ballistic missile program.

OPERATION OF ATLANTIC MISSILE RANGE

Mr. MAHON. The management and operation of the Atlantic Missile Range is contracted to Pan American World Airways, Inc. This contract was discussed in our hearings last year. As a result of those hearings, the committee ordered a staff investigation into the matter. The investigators reported that while the Atlantic Missile Range could be operated at present by civil service personnel at a somewhat lower cost than under contract operation, the present management was effective and since very substantial costs as well as temporary disruption of range operations would result from an attempt to transfer the range to direct Government operation, no change should be made at this time.

Mr. Secretary, do you believe it is important for the Air Force to develop an in-house capability to operate the Atlantic Missile Range?

Mr. CHARYK. The operation of a range of that character is a rather specialized job and I doubt that it would be the wise thing to do, to attempt to convert the operation of this range into an in-house capability. The flexibility that a contract relationship affords permits, for example, people to be drawn from a large reservoir of talent and to be sent to various down-range stations for short periods of time. It would be difficult to recruit people on a permanent basis for assignment at some of the down-range installations.

Also, we have no similar requirements in the Air Force so that unless we duplicate capabilities we would have to try to recruit people on the basis of being assigned for very long periods of time to these installations. I think it would be extremely difficult to get the type of people that are necessary under these restrictive conditions. We have continued to study the problem and our studies have continued to show that on an economic basis, the contractor method is operating satisfactorily and quite competitively as contrasted to proceeding on an in-house basis. We also think that it permits the utilization of more capable talent than we would be able to bring into the picture if we were to follow the other route.

Mr. MAHON. The military have a way of saying that time passed a certain weapon by, like time has passed by the B–36.

Is it the implication of your testimony that maybe civil service is to some considerable extent outmoded by the trends in modern Defense Department operations?

Mr. CHARYK. I would be reluctant to agree with that as a general statement. I would simply point out that in the case of the operation

of a missile range I do not think that that is an appropriate place to attempt to do the job through the civil service structure.

On the other hand, I am sure that there are many other activities where the civil service method is extremely effective.

Mr. MAHON. I am not sure what the answer is to this problem. That is a Government range and it is the Government's business. It is the operation of a program that will continue insofar as we know, for many, many years. What the answer is, I do not know, but I thought this was a rather provocative statement on the subject in the magazine to which I have made reference.

REORGANIZATION OF AIR RESEARCH AND DEVELOPMENT COMMAND

Mr. Secretary, I believe you made some reference in your testimony to the reorganization of the Air Research and Development Command.

In a personal conversation I had with General Schriever last year, he made reference to some important things he was going to do by way of reorganization. What is the reorganization picture within the Research Command and within the Air Force itself?

Mr. CHARYK. I might make a few preliminary comments and perhaps General Wilson would like to augment my statement.

Basically, the reorganization of ARDC has been in the direction of trying to establish a management structure that would permit the weapon system development job to be more effectively done. Basically, the concept is to divide the command into four major functional divisions; one dedicated to the ballistic missile and space system developments which would be located in California; one dedicated to the development of the aeronautical systems which would be in Dayton; one dedicated to the command and control systems to be located in Bedford, Mass.; then finally the fourth division, the research division, with headquarters in Washington.

The idea would be to bring together at these centers all of the talents necessary for the management of weapon systems development programs and by that I mean the technical staffs required to provide the technical guidance, the military direction of the program through the Air Research and Development Command, and the procurement functions provided by the Air Materiel Command.

This pattern was established for the first time in connection with the ballistic missile program and this is basically an expansion of that concept to our other development areas.

General Wilson may want to comment in regard to the problem as it relates to the Air Force as a whole.

General WILSON. I think that Dr. Charyk has responded to the question rather fully in general terms.

As far as the Air Force as a whole is concerned, the principal difference probably will be in the management of weapons system programs. What we hope to accomplish here is to establish a headquarters that confines itself to overall supervision, general administration, and policy guidance. We would put in the hands of the weapon systems manager on the spot the responsibility to do the job and the tools with which to do it. This means that among other things, he would take over some of the programing responsibilities now accomplished by the Air Materiel Command. This will certainly require

a change in Air Force regulations and it might conceivably require some legal assistance, change in the law.

At the centers when a new system is established an ARDC officer will be named the responsible head for that system. It is contemplated he will remain the head of that system until the item enters the inventory so that we know who is in charge. He will have present to assist him AMC people to provide him services in contracting and in procurement. The project officer is the boss. Present for duty at the same time with him will be officers of the Training Command who will be charged with establishing the training processes all the way through, the AMC logistic officers who will be charged with developing the plans for the logistic support of this system after it is in the inventory, and officers of the using command, who will, from the very beginning, start laying down the operational program.

Mr. FORD. Will these subordinates start with the inception of the program and carry it on until it becomes a part of the inventory?

General WILSON. Yes. The weapon systems office will remain in being as long as the weapon is in the inventory.

We would expect to have these people present for duty throughout the life of the weapon. This is the idea and that, in very general terms, is the scheme of the operation.

Mr. MAHON. This concludes our hearing, gentlemen, and we realize it has been a bit spotty. We have not undertaken to go into all of these projects. Of course, we do not have the responsibility for the program's administration but we do feel that we owe to the committee and to the Congress the duty to look into these matters insofar as we reasonably can. Your presentation has been very interesting and helpful and we thank you for your appearance.

APPENDIX

COORDINATION OF BASIC RESEARCH

(The following additional information was furnished in response to the interrogation by Mr. Mahon on p. 51:)

The Office of Science within the O.D.D.R. & E. is charged with the basic responsibility of the Department of Defense for program review and integration of the basic research program. This Office consists of staff divisions of physical science, mathematical science, geophysical science, biological and medical sciences, and psychology and social sciences. It is assisted by a Coordinating Committee on Science, comprising the three chief scientists of the three military departments, the Director of the Office of Science, and their respective deputies. The Office of Science further provides secretariat to and obtains valuable scientific advice from three advisory panels: one in general science, one in medical science, and one in psychology and social sciences. Carefully selected specialists in various fields of science sit on these panels.

A few examples of the role of the Office of Science in the basic research effort of my office are—

(1) The Office played a major role in the evolution of the fundamental Department of Defense policy on basic research support.

(2) On an annual basis, the staff of the Office of Science reviews basic research line items in the budget submissions of the Departments and ARPA, examines them for conformity with Department of Defense requirements and policies, and recommends to the Director of Defense Research and Engineering their approval or disapproval as appropriate.

(3) On a continuing basis, the Office of Science, with the help of the Coordinating Committee and the advisory panels, reviews the actual programs of the Departments to assure support of research of high quality and appropriate content and to assure that unwarranted duplication does not exist.

(4) The staff of the Office of Science maintains a day-to-day working contact with scientists in their respective fields in the Department of Defense, in industrial laboratories, and in the academic community, in order that routine programing and special activities in the basic research field may be handled in a manner best serving the national interest and reflecting the guidance received from such sources as the Federal Council on Science and Technology and the National Science Foundation.

IMPORTANCE OF RELATIVE THRUST

(The following statement was submitted in response to the interrogation of Mr. Flood on p. 84:)

Importance of relative thrust of rocket boosters can be summarized as follows:

(1) We have sufficient thrust now to carry the payloads desired and to carry them the required distances.

(2) We have enough thrust to carry on our current military space work such as the SAMOS, MIDAS, and DISCOVERER projects.

(3) To take care of the needs for manned space there are two rocket boosters under development, the SATURN and the NOVA. These boosters will provide the necessary thrust for manned space efforts and other deep space explorations.

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CORRECTION

Paragraph 2 on page 738 of volume V—Procurement, should be corrected to read as follows:

"First with respect to the reluctance of the Department of Defense to agree to establish a Defense Supply and Service Administration, it should be recalled that the Commission members themselves were not unanimous respecting the merits of this proposal. The Secretary of Defense, a man of vast business and industrial experience, regarded this recommendation as unsound. President Eisenhower, whose judgment reflects many years' experience as a military commander, administrator, and statesman, has disagreed with the idea. No Assistant Secretary of Defense with actual responsibility for supervising the performance of logistics functions has endorsed this proposal. The proposal has not been rejected perfunctorily. Upon a number of occasions it has been given careful study."

(The following information was requested by Mr. Flood on page 467):

NUCLEAR AIRCRAFT

(This section furnished separately inasmuch as it is classified.)

DISPERSED FIGHTER BOMBER

This is a term which relates to the techniques for enhancing the survival of this type aircraft by scattering them into small groups, operating from unprepared airfields. Directly related to this terminology are the VTOL (vertical takeoff and landing) and the STOL (short takeoff and landing) aircraft.

"HUMANITIES" BIOLOGISTICS AND BIOMECHANICS

While the reference to the word "humanities" is not well understood, it is possible that this refers in part to the Air Force program of personnel selection, classification and evaluation testing. All officers and airmen entering the Air Force are evaluated with regard to their aptitudes and interests. In addition, a very large number of proficiency tests are used to assess an airman's job knowledge, need for further training, and work effectiveness. Operational personnel tests used for selection, assignment, and proficiency measurement rapidly become obsolete with changing weapon systems, and need to be replaced in accordance with regular schedules. Both new and replacement personnel tests are developed in the research and development program. Some of the newer work in this area is concerned with the development of tests which will identify those airmen who are unable to meet the minimum standards of behavior and emotional stability for military service, an area of evaluation which has received less attention than tests concerned with selection for training and job assignment. In fiscal year 1961, the Air Force proposes to spend $300,000 on contracts for research of this kind.

Neuropsychiatric tests for space were developed as a minor part of a single project to obtain means for selecting persons best suited physically and emotionally for space flight. Tests were developed to assist the NASA to select Project Mercury astronauts. The Air Force proposes to continue to refine these tests, to provide means for monitoring the astronauts' condition for space flights and to ascertain the biomedical capabilities essential for efficient performance in space flight.

With respect to our life sciences program related to future space operations I should like to make a general statement. The Air Force has had, since World War I, a capability to conduct research in the general area of the sciences related to man. This capability has increased in both scope and magnitude during the intervening years. Because of this dynamic, imaginative program in aviation medicine, human engineering, and other aspects of the total life science research effort, man has been enabled to keep up with the progressively more demanding requirements imposed by the rapid growth of aircraft performance. The direct benefits to civilian as well as military aviation have been large.

When one looks at the history of aviation, Air Force officers, both present and past, dominate the life science literature. Such examples as Major General Armstrong's early experiments and classic textbooks in aviation medicine; Colonel Stapp's work on deceleration; Colonel Lovelace's work on oxygen equipment and parachute escape; and Colonel Henry's pioneering work—putting mice and monkeys in the space environment with AEROBEE rockets during the years 1948 to 1951—are well known and remembered examples of outstanding advances by Air Force scientists, made possible by a sound background of research preparation in our laboratories.

Our present capability is greater than at any time in the past. Twelve hundred Air Force life scientists are actively engaged in studying the problems of aerospace. We are able to send animals safely on ballistic flights, and we are equally prepared to place them in orbit. Prior to the establishment of the NASA the Air Force had proceeded with the development of a manned capsule to mockup, a development directly attributable to the fundamental knowledge and skill of the Air Force scientific team.

It is not my intention to imply that the Air Force capability in the life science area is all encompassing, but I do wish to state categorically that the Air Force has the largest single competency that exists in the United States.

In the life sciences program we have used some terminology which is not clearly understood. The terms "biologistics" and "biomechanics," with a companion term "radiobiology," were brought into use to administratively group related projects in the area of life sciences research. Since most projects involve work in several scientific areas, groupings such as medicine, biology, physiology, are largely meaningless and practically impossible to relate to man-hours, dollars or project numbers.

"Biologistics" concerns the effort required to support life and health and means to protect and sustain man against the physiological stresses in natural and artificially produced environments of flight and other Air Force operations. The Air Force proposes to spend about $5.5 million in this area in fiscal year 1961.

"Biomechanics" concerns the research on mechanical stresses (acceleration, acoustic energy, electromagnetic radiation, vibration, etc.) and means to protect man in flight and in Air Force operations. The Air Force proposes to spend about $1.4 million in this area in fiscal year 1961.

"Radiobiology" concerns research on the effects of all forms of ionizing radiation on man and on means to prevent injury. The Air Force proposes to spend about $104 thousand in this area in fiscal year 1961.

Snow and Ice Removal From Airstrips

Shortly after World War II, it was realized that the longer runways required for jet aircraft and the need to keep air bases operational at all times, regardless of weather conditions, would present a serious snow removal problem.

The Air Force in cooperation with Army Corps of Engineers in 1949 initiated a project with the objective of developing equipment suitable to the task. In subsequent years, numerous commercial and Government developed equipments have been tested. From the development viewpoint, this 10-year period has produced equipment suitable for the removal of snow and ice from runways at a speed compatible with minimum disruption of flying operations.

The Air Force feels that the development of equipment for snow and ice removal is relatively complete. The need for economy throughout the Air Force operation coupled with the relatively satisfactory status of equipment for the snow and ice removal task has caused us to reduce development in this area to a minimum. Development support of past projects is continuing; however, there is only one new item to be procured for development test in the 1960–61 winter season. The item to be tested consists of two obsolete jet engines on a standard truck. The engines are mounted in a manner to blow the snow from the runway with the jet blast and melt residual ice with the heat of the engine exhaust.

In addition to mechanical means for the removal of snow and ice, the Air Force has tested numerous chemicals none of which have been found completely satisfactory due to various causes, such as erosion of equipment, and deleterious effect on the grass used to keep down dust on the edges of runways in the summertime, and ineffective in terms of time and cost.

Convertiplane and Short Takeoff Airplanes

The name "convertiplane" was coined in the early 1950's to describe aircraft that take off vertically or with a zero ground run using a helicopter rotor system and convert in flight to something approximating an airplane configuration where the aircraft is supported by lift from fixed wing surfaces. The Army participated with the Air Force in the development of two aircraft of this type, the McDonnell XV–1 and the Bell XV–3, both of which were successful in demonstrating the feasibility of their respective types of "convertiplane."

In the period since these two developments were undertaken the need for vertical takeoff and landing (VTOL) performance in a number of mission areas has developed and a variety of new technical approaches to satisfying the need for VTOL have evolved which are not restricted to the use of the helicopter rotor lifting system. Represented among these approaches are the Air Force X–13 and X–14 jet-powered VTOL research airplanes and the X–18 tilt wing turboprop VTOL research airplane, each designed to prove the feasibility of a particular design approach, e.g. "jet tail sitter", "horizontal attitude deflected jet" and "tilt wing." It has been established that to achieve true short takeoff and landing (STOL) performance (1,000 feet or less) in the larger types of aircraft involves the installation of quantities of power and sophistication of controls comparable to the VTOL aircraft and further that VTOL aircraft can be so designed as to permit STOL operation at increased operating weights, i.e. longer range or greater payload.

Considering these factors a categorization of aircraft has evolved which encompasses both vertical and short takeoff and landing (V/STOL). This concept includes all the various approaches from the helicopter at one end of the spectrum to jet powered aircraft at the other. The selection of the design concept is a function of such things as cruising speed, hover endurance and the like.

As the requirements for V/STOL weapon systems become firm and resources are allocated the development and manufacture of small quantities of selected types of V/STOL aircraft will be undertaken for operational suitability testing.

Logistical Problems Related to Airlift Operations

An air cargo handling system project has been established to enhance the successful accomplishment of the air logistics mission. Objectives of this project are to develop equipment, procedures and techniques to permit the rapid deployment of combat forces and their equipment, the timely resupply of these forces while realizing the economies in procurement, packaging, storing and distribution inherent in the use of air transportation.

Objectives will result in (1) lower stock levels of supplies in forward areas; (2) no rear area stock piling as in World War II; (3) a logistic system that will react in a few hours; (4) a complete cargo handling system compatible with various modes of transportation; and (5) standardizattion of methods, techniques and equipment used in packaging, marking, documenting and handling.

Phases:

(1) Movement of cargo from manufacturer to terminal.
  (*a*) Packaging with emphasis on minimum tare weight and cube.
  (*b*) Palletizing.
(2) Handling at terminal.
  (*a*) Receiving.
  (*b*) Sorting and further unitizing.
  (*c*) Temporary storing or warehousing.
(3) Documentation.
(4) Aircraft loading.
  (*a*) Movement of cargo to aircraft.
  (*b*) Movement of cargo within aircraft.
  (*c*) Rapid tiedown and release.
(5) Airlift of cargo for delivery to user by short-haul.
(6) Aircraft unloading.

Status:

Evaluation study: Contract with Douglas Aircraft Corp. on June 1, 1959. A common system of loading platforms, tiedowns, and techniques is being developed for C–124, C–130, and C–133 for a rapid load system.

As the result of a worldwide study of air cargo loading problems, 4,000- and 40,000-pound cargo loaders are being developed to facilitate loading of USAF and Army cargo.

A common rail delivery system for air cargo drop for Army and USAF main cargo is being developed to prevent duplication of systems and specialization of aircraft.

An electronic air cargo weight and balance computer has been developed and is in operation.

Estimated completion date of this project is fiscal year 1965.

Future Ground Support Equipment

GROUND SUPPORT IN GENERAL

1. What do we work with?

The USAF uses the same types of ground equipment which industry would use to perform similar tasks. More specifically, Air Force ground equipment can be broken down into the following two categories:

(*a*) *Specialized equipment peculiar to one weapon system.*—Such equipment, supporting a single weapon, may be either commercial equipment, bought for this special purpose, or it may be military equipment (no commercial counterpart) developed specifically to support a particular weapon.

(*b*) *General purpose equipment.*—Snowplows, trucks, and handtools exemplify this. Such equipment is procured directly by the Government from its manufacturer and is issued to the field in the quantities required. General purpose equipment may be either a straight commercial item or of military design if no commercial counterparts exist.

2. Who designs it?

(*a*) *Specialized equipment peculiar to one weapon system.*—Such equipment is either bought off the shelf or designed and developed while the weapon system itself is under development. It sometimes is designed and developed by the weapon system contractor. The equipment is usually obtained from a source other than the weapon system contractor by competitive procurement. It is Air Force policy to encourage and require maximum use of vendors and subcontractors to supply this class of equipment. We do, however, hold the weapon system contractor responsible for the technical integrity and the suitability of all equipment peculiar to his weapon system.

(*b*) *General purpose equipment.*—The Government usually obtains this equipment directly from vendors if it is commercial or semicommercial. If the equipment is military in nature, it normally is obtained by a Government development contract, competitively awarded. Wherever possible, we use equipment developed by the other services.

All equipment which is military is designed and developed by industry to Government specifications, to obtain maximum possible interchangeability of components, standardized operation, and common logistic support. Commercial equipment, on the other hand, is usually obtained "as is" from the manufacturer's production line. We do not want to develop items that are already available. We have found that commercial equipment usually can be effectively supported by using commercial distribution facilities and through common part support contracts established by the services and by GSA.

3. What is the future of ground support equipment?

(*a*) *General purpose equipment.*—Conditions on the ground have not changed as radically as those in the air. For example, while our missiles require us to transport different fuels and oxidizers, the basic means of transporting them on the ground (by tank car, truck, or pipeline) have not changed and probably will not change radically. Wherever possible, we will adopt new labor-saving equipment and follow industrial and commercial trends when costs and the advantages are favorable. Where military requirements dictate, we will contract with industry to develop new military items to support the Air Force effort.

(*b*) *Specialized equipment peculiar to one weapon system.*—In developing new weapon systems, we try wherever possible to use support equipment developed for earlier systems or for general use. New weapons systems do require new types of ground support equipment, however, and these equipments normally must be developed along with the military vehicle, be it an aircraft or a missile.

Peculiar ground support equipment is a part of the total weapon system and

must receive the same emphasis and consideration as any other part of the weapon.

It is difficult to predict specific trends in support equipment because of the nature and characteristics of future weapons themselves. The support equipment must be designed and configured to support the weapon. It is therefore greatly dependent upon the nature and requirements of future weapons as they develop.

Research on Automobile Accidents

The following is submitted in reference to a question raised by Mr. Mahon on page 503 of the hearings:

Accidental trauma, primarly automobile accidents involving personnel off duty and off post, has been the major cause of man-days lost from duty in the military for the past several years. The Commission on Accidental Trauma of the Armed Forces Epidemiological Board (AFEB) has recommended various studies aimed at reducing this manpower loss. In 1955 the AFEB recommended support of a contract with Dunlap & Associates, Inc., Stamford, Conn., for "research on the technique of accident analysis and prevention." One portion of this contract was the study of the effects of automobile design on accident rates.

This contract ran from December 1, 1955, through June 30, 1957. It was supported by Army research and development funds to the extent of $66,874.

Defects in Atlas Weapons System

(The following information was inserted in the record at the request of Mr. Flood:)

Reply to Attention of: AFABF.
Subject: Defects in the Atlas Weapons System.
To: Hon. Daniel J. Flood,
House of Representatives.

1. This is in response to the request of Mr. Michaels that we furnish a comprehensive statement concerning a letter dated March 2, 1960, which you received from "A Group of Disillusioned Career Airmen" of the 576th Strategic Missile Squadron at Vandenberg Air Force Base.

2. The complaints of inefficiency and low morale related by these airmen have their roots in two problems upon which they dwell in detail; namely, (1) insufficient trailer parking facilities at Vandenberg and (2) lack of promotions.

3. As of February 1, 1960, there were approximately 400 permanent trailer spaces on Vandenberg Air Force Base and approximately 200 personnel on the permanent waiting list. Until recently, trailer spaces were assigned by date of rank and grade. The base commander, in order to assist hardship cases involving lower grade airmen, developed a plan to park trailers temporarily next to barracks not then in use. However, due to an Air Force Ballistic Missile Division requirement for these buildings it was necessary to discontinue this plan and begin to phase out these particular temporary facilities. Complete phase-out of this trailer operation will be effective approximately April 1, 1960, which is the date for the beginning of major construction in this area.

4. In order to expedite the move of persons in temporary trailer spaces, the assignment procedure was realigned. The present procedure is to take one person from the top of the regular waiting list and one from the temporary park as spaces become available for assignment in the permanent park. Additional temporary spaces have been obtained at other locations on the base. Present attrition would indicate that all temporary personnel will be relocated in permanent spaces in the next few months.

5. Headquarters, Strategic Air Command, has approved a request for an additional 104 permanent trailer spaces, and forwarded the request to this headquarters on March 15, 1960. This request is presently being processed through the Air Staff.

6. Concerning the promotion problem, it is Air Force policy that all eligible airmen be afforded an opportunity for advancement to the next higher grade. However, there are certain criteria which must be met in order to effect the promotion of individual airmen. In addition to specified time-in-grade and time-in-service criteria, the airmen must have achieved the skill level which

supports the next higher grade. Coupled with the skill-level requirement is the grade-vacancy requirement. Vacancies must exist in the next higher grade in the specific career area. If these criteria are met, the commander concerned then recommends the best qualified of his airmen for promotion. If the best interests of the Air Force are to be served, it is essential that only the best airmen be recommended for, and receive, promotion to the next higher grade.

7. Due to the lack of specific information concerning names, grades, and career fields of the airmen who authored the letter to you, exact promotion data cannot be furnished. It is probable that the proportionate share of the airmen promotion quotas received by the 576th Strategic Missile Squadron was insufficient to insure the promotion of all eligible airmen. However, this situation is prevalent Air Force-wide due to the limited numbers of quotas available as opposed to the large number of airmen eligible for advancement. Under these circumstances, competition among the many eligible airmen for the limited quotas available is extremely keen, and it is inevitable that many airmen with fine records cannot be promoted.

8. I trust that you will find the above information responsive to your request.

Sincerely yours,

ROBERT J. FRIEDMAN,
Major General, U.S. Air Force,
Director of Budget.

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